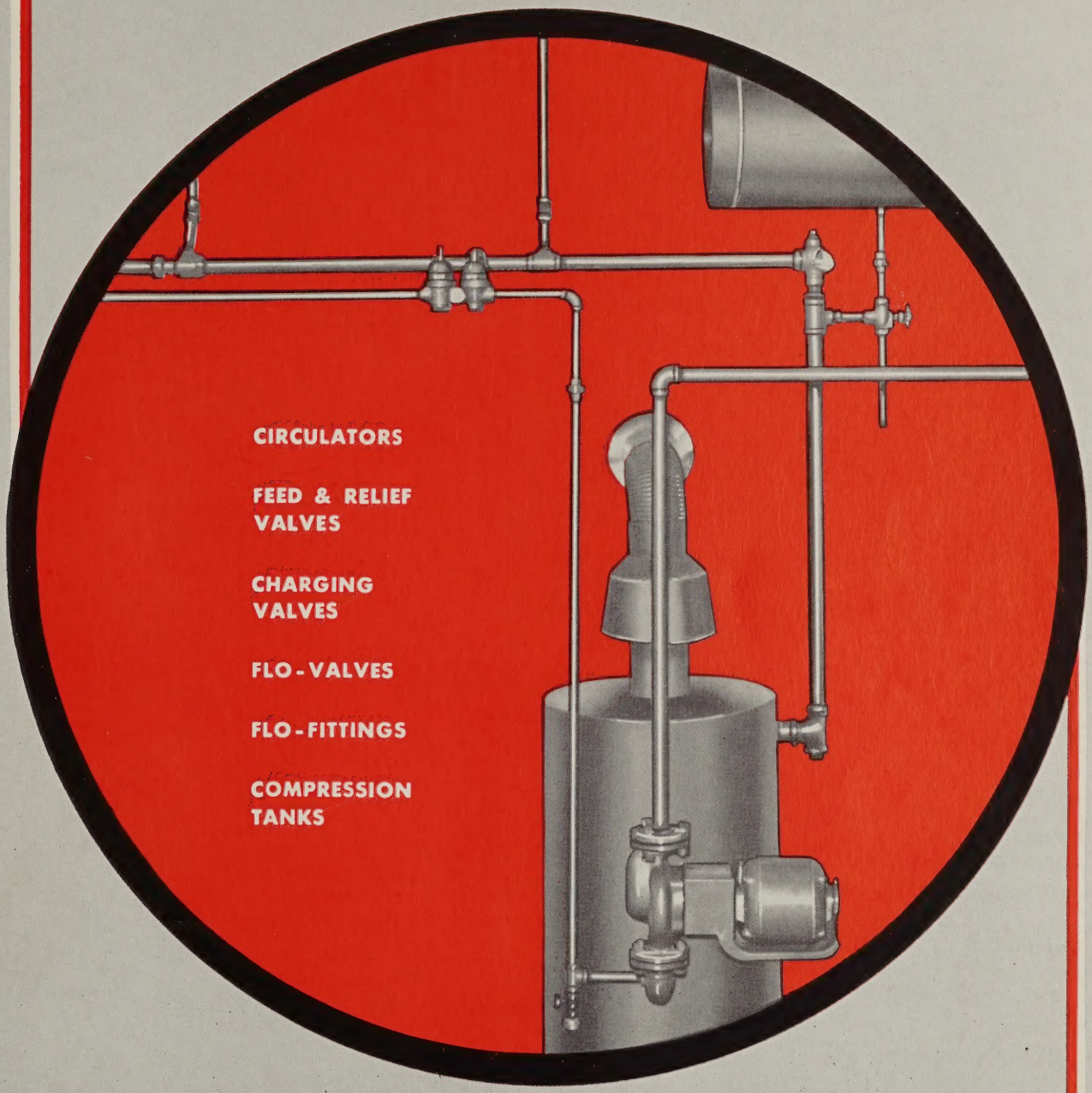
TRANE

BULLETIN DS-355 MARCH, 1949



HOT WATER HEATING SPECIALTIES

THE TRANE COMPANY - LA CROSSE, WISCONSIN

New Design • • New Features

CUTS COST OF
Stocking
Installing
Operating

BETTER HOT WATER HEATING AT LOWER COST

with the new Model C

TRANE HIGH HEAD CIRCULATOR

and accessories

TRANE HIGH HEAD HOT WATER HEATING provides a flexibility and accuracy of control rarely seen in a heating system. This flexibility enables it to meet any building condition or heating requirement. Small or large homes, hospitals, schools, commercial or industrial buildings can be economically and effectively heated by this method. . . . With this equipment it is also possible to extend the heating system horizontally to include several buildings, uniting their heating plants into one more efficient central system.

High Heads for Low Cost

Key piece of equipment is the new Model C Trane High Head Circulator. This silent, electric-motor driven pump provides positive and uniform circulation of hot water through the piping circuit of the system.

The new Model C operates against even higher heads than its predecessor, the outstanding Model B. This increases the Btu carrying capacity of the water in the system, thus reducing pipe costs due to the resultant reduction in pipe sizes that is made possible.

In addition to its use on new, modern hot water heating systems, Model C is also used to improve circulation in old gravity systems and for circulating hot or cold service water. In the case of old systems where normal capacity of pipe has been reduced due to liming or rust, the high head feature of Model C commonly enables it to deliver the full quantity of water for which the system was originally designed, thus eliminating the need for costly repairs or replacements.

Cuts Stocking Costs

This new circulator is designed with interchangeable flanges — a feature called Flange Flexibility. Due to an interchangeable flange arrangement, the same basic unit may be used for either 1″ or 1¼″ service. A second basic unit may be used for either 1½″ or 2″ service. It is only necessary to stock *two* basic units, along with *four* inexpensive sets of flanges, to be in position to make immediate delivery of any one of *four* sizes of circulators. Stocking costs are cut one-half. Space used for stock is cut one-half.

Two-Way Installation

For the further convenience of distributor and contractor, new Model C is designed so the same unit may be applied for either vertical or horizontal installation. For vertical piping, install it as it comes. For horizontal piping, simply remove four nuts and rotate the pump body while keeping the pump and motor shaft horizontal to the floor for proper lubrication. No need to stock two types. This new Model C is two-in-one.

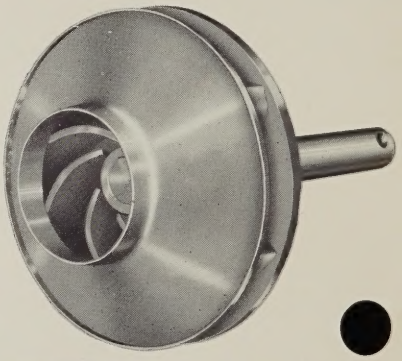


FIGURE 2 — This enclosed impeller is no "paddle-wheel." Carefully engineered for efficient service against high operating heads, its exclusive design features make the new Model C circulator outstanding.

The Safest Circulator

This unit has been designed to be the safest circulator on the market. Absolutely no exposed rotating parts. No way for a child or incautious person to be injured. In the interest of safety, all prospec-

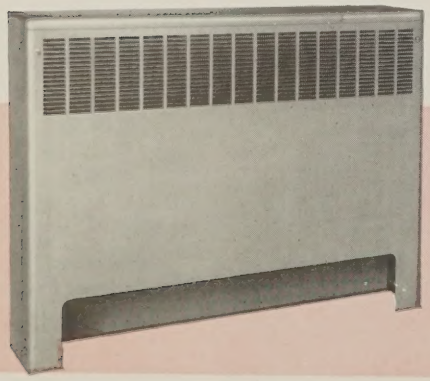
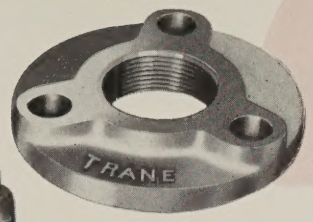


FIGURE 1

TRANE CONVECTOR-RADIATORS, used in combination with the Trane specialties described in this bulletin, make possible the design of a heating system that is economical to buy, to install and to operate. . . . Each convector consists of a high grade furniture steel cabinet in which there is a compact, light-weight Trane heating coil. Actual tests have shown that these units produce heat *four times faster* than old-fashioned radiators. They contain no moving parts to create noise. Quick and positive heat control is obtained without the use of valves. . . . Attractive in appearance, convectors may be installed in the finest home. Yet because of their durability, they can be used for commercial and industrial applications as well. . . . Available in a full range of sizes.

••New Economy



FLANGE FLEXIBILITY

FIGURE 3 — By stocking only *two* basic pump-and-motor units, plus four inexpensive sets of interchangeable flanges, distributors can make immediate delivery on any one of *four* circulator sizes. Cut stocking cost one-half!

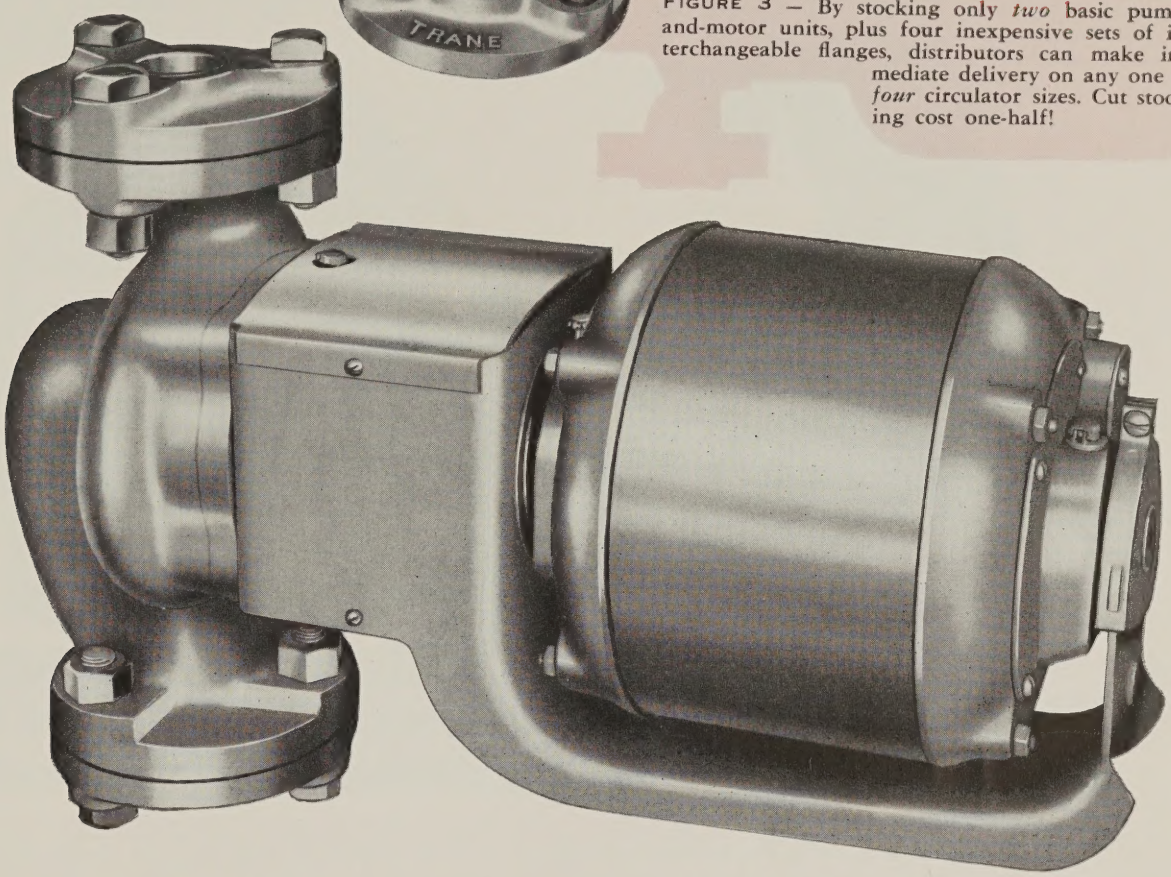


FIGURE 4 — This new Trane Model C High Head Circulator is really a beautiful piece of equipment with its sturdy one-piece mounting and its striking metalescent blue finish.

tive purchasers are urged to check the unit they intend to buy with this vital fact in mind. Devices with exposed couplings or with makeshift shields can be extremely dangerous and should never under any circumstances be installed openly in a basement or utility room.

Exclusive Trane Impeller

The power of the new Model C to operate against high heads is due in large measure to the carefully engineered impeller. Instead of the crude "paddle-wheel" type impeller so commonly installed in circulators, Trane engineers have given this element the same careful design consideration they would for one of the senior members of the Trane pump line.

The result has been a single-suction, enclosed type impeller that has long, smooth, scientifically curved blades that efficiently and effectively deliver full-rated quantities of hot water against high head pressures. This is an exclusive Trane design, available only in the new Model C High Head Circulator.

Improved Flexible Coupling

A new flexible coupling has been designed for this unit which eliminates all metal-to-metal contact between pump and motor except for the protective grounding strip. This arrangement provides protection against parallel misalignment, lengthens the life of the equipment, and isolates motor hum from the piping system of the building.

Easy to Handle

Model C circulators are delivered in compact individual cartons that are easy to stock and easy to handle. Flanges and accessories are individually packaged for most economical stocking and a minimum of handling. See next page for other features.

Powerful Model C HIGH HEAD CIRCULATOR permits use of smaller pipes . . . cuts installation costs

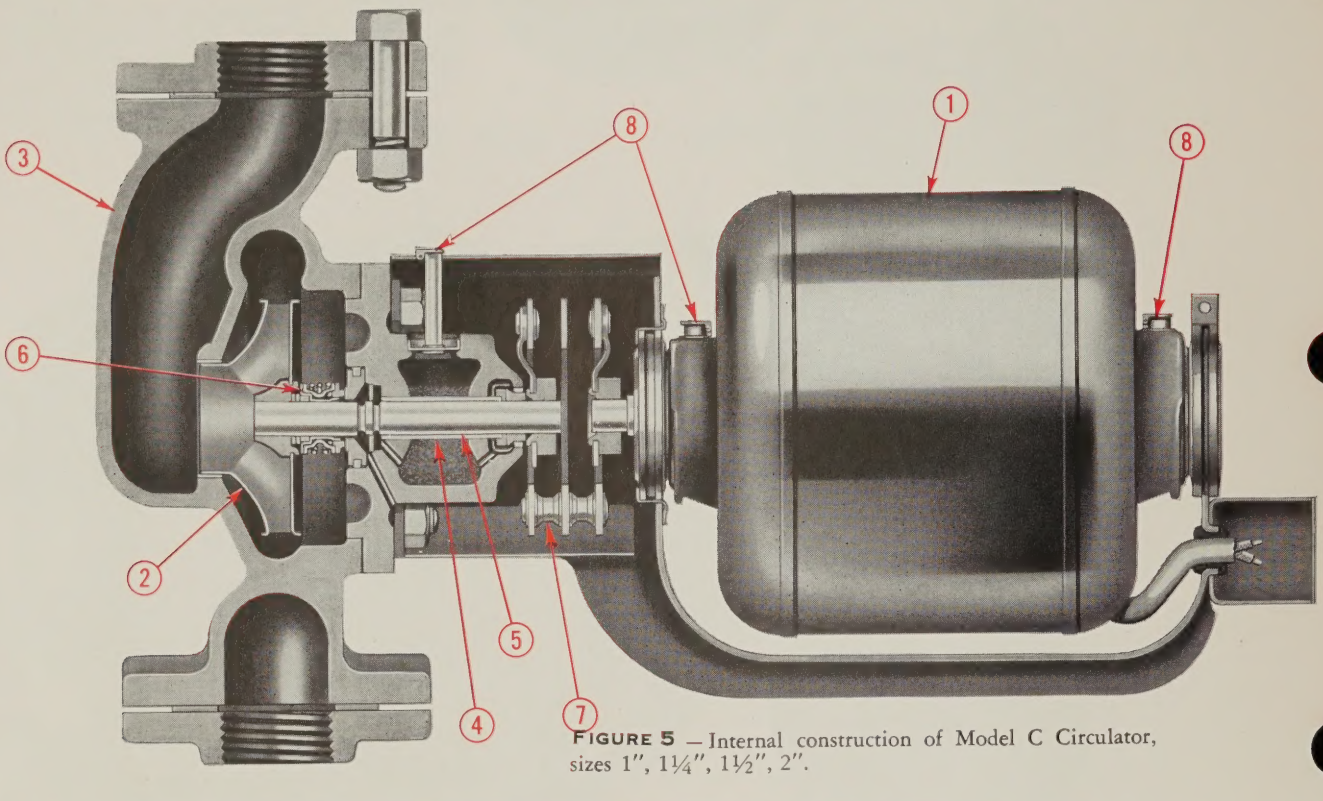


FIGURE 5 — Internal construction of Model C Circulator, sizes 1", 1¼", 1½", 2".

MECHANICAL SPECIFICATIONS

1. MOTOR: Nationally-known motors are used, with vibration balanced out before assembly. Quiet-operating, 1750 rpm, non-radio interfering, rubber isolated from pump and piping to eliminate hum. Equipped with automatic, thermal safety cut-out switch which stops motor in case of overload or overheating due to foreign matter, low voltage, or lack of lubrication.

2. IMPELLER: Single suction stamped brass impeller used on sizes through 2" assuring smooth water passages for efficiency, and proper balance for quiet operation. Close limit tolerances, for minimum slippage losses and high efficiency. Cast impellers used on 2½" and 3" sizes.

3. PUMP BODY: Cast iron body designed to provide smooth water flow into and from impeller without frictional or turbulence losses. Liberal design between flanges and pump body.

4. BEARINGS: Units through 2" use porous sintered bronze bearings which absorb and retain oil from bearing bracket wicking. Self-lubrication, long life, and silent operation is assured. For 2½" and 3" sizes, two diamond bored bronze bearings are used.

5. SHAFT: High grade shafting steel is centerless ground to a predetermined highly accurate finish for maximum service.

6. SEAL: Seal between shaft and bearing bracket on units through 2" employs a high grade, low friction coefficient material designed for this specific application. It runs against a ground-and-lapped cast iron surface, thereby insuring perfect operating conditions. This bellows-enclosed water seal safeguards against lubrication failure by absolutely preventing entry of water into bearings. On 2½" and 3" units, seal is morganite seal ring, rotating against highly machined and polished cast iron surface.

7. COUPLING: Double engagement, non-metallic, silent flexible disc type of coupling is used. Although torsionally rigid, it provides for both angular and parallel misalignment. Both coupling and shaft are enclosed for safety. Accessible by removing cover plate.

8. LUBRICATION: Oil lubrication, recognized as being the superior method of lubrication, is accomplished through Gits fittings. Oil is carried from oil reservoirs by filter wicking to outer surface of the sintered bronze bearing. This type of lubrication effectively prevents passage of grit or dirt to bearings or seal, eliminating leakage and excessive wear.

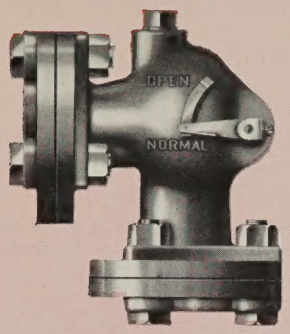


FIGURE 6
Angle Flo Valve

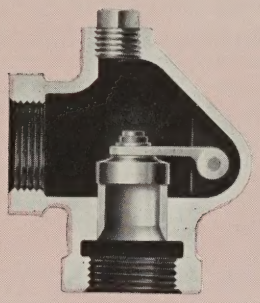


FIGURE 7
Angle Flo Valve

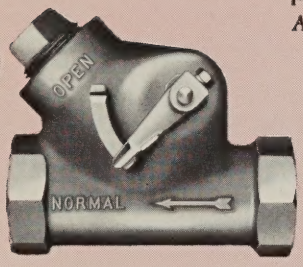


FIGURE 8
Straightway Flo Valve

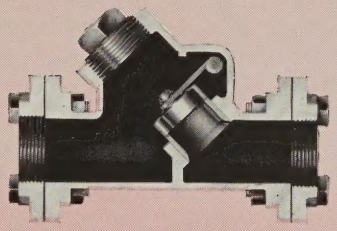


FIGURE 9
Straightway Flo Valve

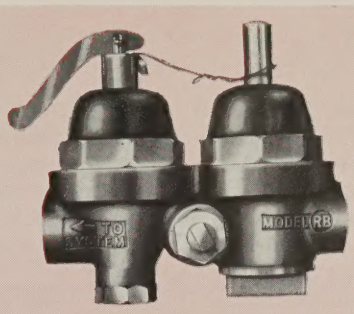


FIGURE 10
Automatic Feed and Relief Valve

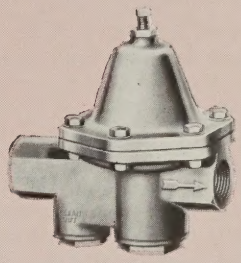


FIGURE 11
Regulating Valve

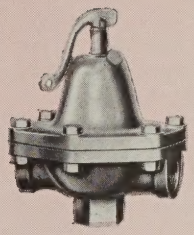


FIGURE 12
Type "35" Relief Valve

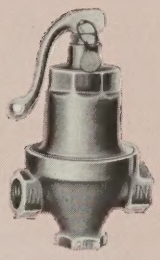


FIGURE 13
Type "36" Relief Valve

Hot water control with Trane Valves

The Trane Angle and Straightway Flo Valve prevents the circulation of hot water in the heating system when heat is not needed. It permits the year 'round use of an indirect water heater by stopping the circulation of hot water to the Convector-radiator, except when the circulator is running. During non-heating periods the boiler water is maintained hot enough to supply domestic hot water from the indirect water heater but the Trane Flo Valve prevents heat from passing to the Convector-radiators. It allows warm water from the boiler to circulate through the heating system only when the room thermostat calls for heat and therefore for circulation of the hot water.

Installation

The Trane Angle Flo Valve (Figures 6 and 7) is mounted directly on the supply riser from boiler, taking the place of an elbow. Only one is required on single zone installations.

Where it is more convenient to make the installation on a straight run of pipe, rather than on an angle, the Straightway Flo Valve (Figures 8 and 9) is used. The Trane Straightway Flo Valve, although different in construction, accomplishes the same purpose as the Trane Angle Flo Valve. It must always be installed in a horizontal position. When a Flo Valve is used in the return line from the Convector-radiators it must be a Straightway Flo Valve.

Trane Flo Valves will work on open or closed systems and should be installed on all forced circulation hot water heating systems to prevent the circulation of hot boiler water when heat is not needed in the Convector-radiators.

Features and Mechanical Specifications

The Trane Flo Valve is a high grade, accurately weighted automatic valve. All bronze working parts are machined and tested with the utmost care in order to guarantee perfect performance. The valve can also be manually operated.

The Trane Flo Valve has a close-grained cast iron body with screwed connections on 1" and 1¼" sizes. All other sizes are double flanged. An adjustable lever is provided in order that the valve can be partially or fully opened, but cannot, for safety reasons, be locked closed. An indicator on the side of the valve shows the position of the flapper.

It positively will not pass heat to the Convector-radiators when the circulator is not in operation.

The use of the Trane Flo Valve assures greater responsiveness to thermostatic control, as the reaction of the system is practically instantaneous when the thermostat calls for heat or shuts the heat off.

The Trane Flo Valve serves to maintain a uniform room temperature during the heating season and prevents overheating and waste of fuel. Complete control of circulation is provided without any supervision.

AUTOMATIC FEED AND RELIEF VALVE

The purpose of the Automatic RB Feed and Relief Valve (Figure 10) is to assure safety and uninterrupted service for a hot water system by filling the system automatically when the pressure drops below 12 to 14 pounds and to relieve the system automatically if the pressure increases above 28 to 30 pounds.

An exclusive feature of the RB Valve is the by-pass which allows quick filling of the system, permits cold water pressure tests, and provides the only positive means of testing the relief valve on the line. It also permits the use of the ideal small seated regulator in a valve which must pass a large volume only occasionally and passes the initial dirty water around the valve instead of through it.

The valve itself is of all bronze, rustproof construction with the seat on the relief valve nickel plated to resist sticking. Diaphragms are phosphor bronze for long life. The Automatic Feed and Relief Valve is installed in the line from the city water supply to the boiler (See Boiler Details, Pages 24 to 26).

REGULATING VALVE

This valve (Figure 11) is ideal for service where the supply line pressures range as high as 250 pounds and the delivery pressures are from 10 to 150 pounds. An all bronze pressure reducing and regulating valve, it has a standard factory setting of 30 pounds delivery pressure. The unusually large, inbuilt strainer is easily removed by unscrewing the separate clean-out plug. The composition seat disc is accessible and can be easily renewed.

TYPE "35" RELIEF VALVE

A quality relief valve (Figure 12) that is designed for heavy continuous duty, or use where low pressure drop is a factor. Designed to give a system the pressure protection it requires, this valve is accurate and dependable over long periods of use. The extra large and sensitive diaphragm means a minimum of water wastage in a system. ¾" size is available with a standard setting of 28 pounds. However, any setting from 5 to 65 pounds is available by adjustment. Installed on a straight through pipe, the Type "35" Relief Valve permits continuous flow through the valve body. Seat disc is renewable.

TYPE "36" RELIEF VALVE

This type of relief valve (Figure 13) is particularly adapted for range boiler protection. All working parts are of special bronze and the seat disc is renewable. May be used on a straight-way or angle valve hook-up with discharge straight down through a full pipe size outlet. Pressure setting is 30 pounds.

Trane Flo Fittings

For uniform circulation

FIGURE 14
Cast Iron Flo Fitting

FIGURE 15
Cast Bronze Flo Fitting

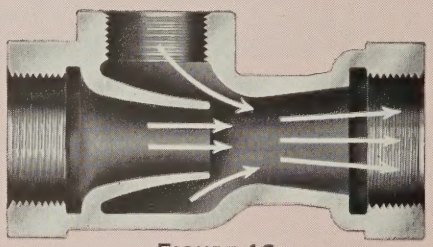


FIGURE 16
Exposed View of Cast Iron Flo Fitting

The Trane Flo Fittings induce a positive and uniform circulation of hot water through each Convector-radiator in a Trane Hot Water Heating System, regardless of its position in the system. They are used on all one-pipe systems. In the past, two mains were required for a hot water system — one to carry the hot water to the Convector-radiators and the other to carry it back to the boiler. With Trane Flo Fittings only *one* main is needed, as they assure the diversion of the proper amount of water into each Convector-radiator.

Figure 16 (exposed view of a Trane Cast Iron Flo Fitting) illustrates how the Trane Flo Fitting equalizes the flow of hot water to a Convector-radiator. As shown by the arrows, the main body of water passes through the central tube of the Flo Fitting, and, by utilizing the Venturi principle, creates a suction effect on the water in the Convector-radiator. This induces a flow of water through the Convector-radiator, insuring a positive circulation and balanced distribution of hot water to the unit without a power-wasting penalty on the circulator.

Installation

The Trane Flo Fitting is used to connect the return branch of a Convector-radiator to the main, taking the place of the usual tee connection. Only one Flo Fitting is required for each Convector-radiator as the supply branch is connected to the main by an ordinary tee. The water velocity in the main should approximate three feet per second to obtain the proper results from the Trane Flo Fittings. The spacing between the Trane Flo Fittings and the supply tees should be approximately three feet in order to prevent the turbulence of the water, created by the Flo Fittings, from affecting the flow of water to the Convector-radiators. (See Page 24, Figures 51 and 52.)

To meet the rapid growth in popularity of copper piping,

Trane Flo Fittings are available for this type of installation. Cast Bronze Trane Flo Fittings (Figure 15) have the same characteristics and diversion capacity as the Cast Iron Flo Fittings (Figure 14).

Features

The Trane Flo Fitting is not dependent on variations in main sizes to obtain proper resistance, and its scientific design induces the flow of water into the Convector-radiators without penalizing the circulator with excessive resistance.

No balancing of Convector-radiators is required, and the completely equalized flow of hot water to each heating unit reduces operating costs.

The use of only one inexpensive fitting for each Convector-radiator reduces costs, and the Trane Flo Fitting permits Convector-radiators *below* the main to be operated as successfully as those above the main.

TRANE CHARGING VALVE

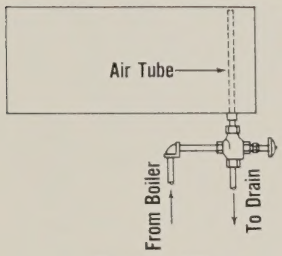


FIGURE 17

The Trane Charging Valve is installed in the line from the boiler to the compression tank. It has a connection for the drain line to the sewer. See above detail (Figure 17).

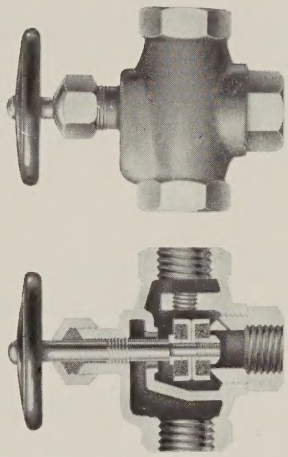


FIGURE 18

When a compression tank becomes water-logged, due to the absorption of air by hot water, the Trane Charging Valve (Figures 17 and 18) permits the draining of the water and its replacement with air without breaking piping connections or using a multiple valve installation. A water-logged tank is manifested by a leaking of the relief valve whenever the boiler is fired. When this occurs, turn the Trane Charging Valve handle all the way to the right, permitting air to enter the tank through the drain connection and allowing water to leave by gravity through the same connection. After 5 to 10 gallons have been drained in this manner, turn the handle back to the left as far as possible, sealing the drain opening and reopening the connection between boiler and compression tank. The tank is now re-charged with air. Normally, it is not necessary to "air-charge" a tank more than once or twice during a heating season. The Trane Charging Valve has a brass body and is a double seated, packed type, three-way valve. A safety by-pass prevents accidental sealing of the compression tank from the boiler.

The piping layouts on Pages 20 to 25 illustrate the installation of the Trane Charging Valve.

COMPRESSION TANK

Tested under pressure, absolutely air tight and fully guaranteed, the Trane Compression Tank adds to the safety of an installation and makes it more efficient. It is usually installed in a horizontal position. See page 17 for capacities and sizes.

The use of a compression tank (Figure 19) in closed hot water heating systems is essential—on high temperature installations it is imperative. Expansion of the heated water is taken up by the tank, eliminating relief valve operation and the consequent intake of make-up water. It also provides a cushion of compressed air against sudden pressures. Trane Compression Tanks are made of heavy gauge steel for long life and trouble-free use.

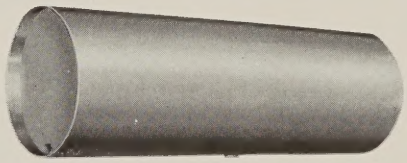


FIGURE 19

AUTOMATIC AIR VENT

FIGURE 20

FIGURE 21

Above is shown the Automatic Air Vent (Figure 20) and the Adapter (Figure 21) for ¼" copper pipe overflow.

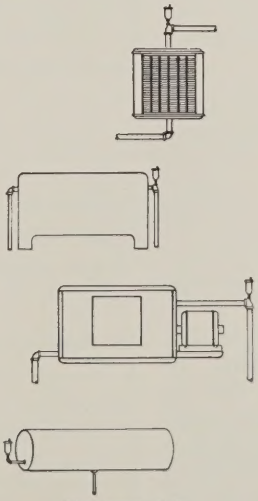


FIGURE 22

The Automatic Air Vent (Figure 20) is a simple and reliable device for automatically removing air from hot or cold water lines. The body is made of nickel-plated brass with Monel metal bearings and levers, copper float and Neoprene valve seat. Built to operate at pressures up to 80 pounds, the air vent solves many perplexing venting problems inexpensively.

The Automatic Air Vent automatically and positively removes the air from the lines of any type of hot water system.

When installed over finished floors and ceilings or over expensive furnishings, an emergency overflow is desirable. In such cases, the Automatic Air Vent can be supplied with an Adapter (Figure 21) for a ¼" O.D. copper overflow. This overflow is run to the most convenient drain. Such overflows are recommended wherever the air vent is used to vent the high point of downfeed hot water systems.

The Automatic Air Vent should always be installed at high point where air would naturally accumulate.

Figure 22 shows the installation of Automatic Air Vents on, from top to bottom, a unit heater, a Force-Flo Convector, an air conditioning unit and a compression tank.

ROUGHING-IN DIMENSIONS

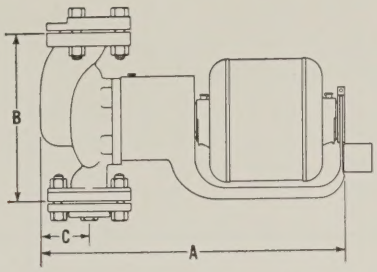


FIGURE 23 Trane 1″–2″ Circulator

TABLE 1
DIMENSIONS
TRANE CIRCULATOR

CIRCULATOR SIZE	HORSE POWER	DIMENSIONS A	B	C
1″	1/6	15 5/16″	8″	2 11/32″
1¼″	1/6	15 5/16″	8″	2 11/32″
1½″	1/6	15 9/16″	9″	2 19/32″
2″	1/6	15 9/16″	9″	2 19/32″
2½″	1/4	17 5/8″	11 3/4″	3¼″
3″ LOW DELIVERY	1/3	19 7/8″	13″	4″
3″ HIGH DELIVERY	1/2	21 3/8″	13″	4″

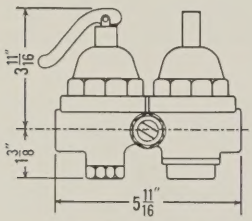


FIGURE 24
Automatic Feed and Relief Valve, ½″ I.P.

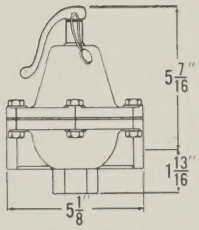


FIGURE 25
Type "35" Relief Valve, ¾″ I.P.

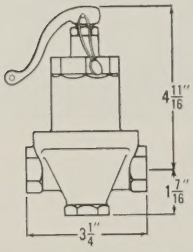


FIGURE 26
Type "36" Relief Valve, ½″ I.P.

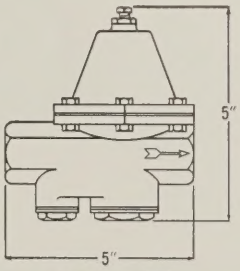


FIGURE 27
Regulating Valve, ½″ I.P.

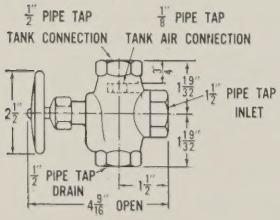


FIGURE 28
Trane Charging Valve

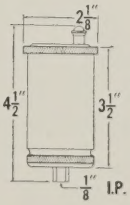


FIGURE 29
Automatic Air Vent

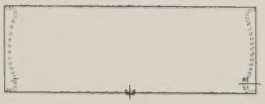


FIGURE 30
Compression Tank

TABLE 2
COMPRESSION TANK SIZES

TANK SIZE	12 X 30	12 X 36	12 X 48	12 X 60	14 X 60
APPROX. WEIGHT	40 LBS.	45 LBS.	55 LBS.	65 LBS.	75 LBS.

NOTE 1: COMPRESSION TANK CAPACITIES ARE ON PAGE 17
NOTE 2: ALL TAPPING SIZES ARE ½″

TABLE 3
DIMENSIONS
TRANE CAST IRON FLO FITTINGS

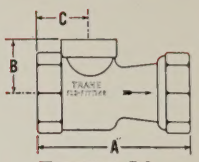


FIGURE 31
Cast Iron Flo Fitting

SIZE	DIMENSIONS A	B	C
¾″	4″	1¼″	1½″
1″	4¼″	1⅜″	1½″
1¼″	5″	1⅝″	1 13/16″
1½″	5¼″	1 13/16″	1⅞″
2″	6″	2⅛″	2 1/16″
2½″	6¾″	2 5/16″	2⅜″

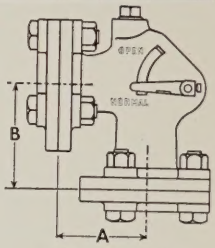


FIGURE 32
Angle Flo Valve

TABLE 4
DIMENSIONS
TRANE ANGLE FLO VALVE

SIZE	CONNECTIONS	DIMENSIONS A	B
1″	SCREWED*	1¾″	2¼″
1¼″	SCREWED*	2¼″	2⅝″
1½″	FLANGED	3″	3½″
2″	FLANGED	3½″	4″
2½″	FLANGED	3¾″	4½″
3″	FLANGED	4½″	5¼″

*DIMENSIONS ARE TO FACE OF TAPPINGS—ALLOW FOR PIPE THREADS

TABLE 5
DIMENSIONS
TRANE CAST BRONZE FLO FITTINGS

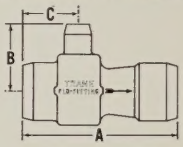


FIGURE 33
Cast Bronze Flo Fitting

SIZE	DIMENSIONS A	B	C
¾″	4½″	1 13/16″	1⅝″
1″	4¾″	1 15/16″	1 11/16″
1¼″	4¾″	2⅛″	1¾″
1½″	5¼″	2¼″	1⅞″
2″	6⅜″	2 9/16″	2⅛″

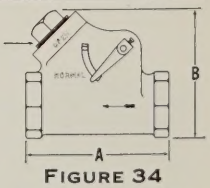


FIGURE 34
Straightway Valve

TABLE 6
DIMENSIONS
TRANE STRAIGHTWAY FLO VALVE

SIZE	CONNECTIONS	DIMENSIONS A	B
1″	SCREWED*	4¾″	4″
1¼″	SCREWED*	5½″	5″
1½″	FLANGED	8 13/16″	6 1/16″
2″	FLANGED	10⅜″	7½″
2½″	FLANGED	11⅞″	8½″
3″	FLANGED	12⅞″	9¾″

*DIMENSIONS ARE TO FACE OF TAPPINGS—ALLOW FOR PIPE THREADS.

DESIGNING A TRANE ONE-PIPE HOT WATER SYSTEM

A Simplified, 5 Step Procedure for Designing Trane One - Pipe Forced Hot Water Heating Systems.

The following design procedure is in accordance with the latest approved engineering practice. Adherence to the method outlined in these steps will assure you of a balanced system correctly designed. The calculations and tables are for Trane systems using Trane Convector-radiators.

1

DETERMINING THE TOTAL HEAT LOSS

Determining the number of Btu's lost in each room per hour (the heat loss of the room) gives the amount of heat (Btu's) that will have to be replaced—if the room is to be kept at a predetermined temperature.

This is done by calculating the heat loss of each room, in Btu's per hour, by one of the standard methods.

Then, to facilitate further calculations, the Btu's per hour are divided by 1,000 so the heat loss will be expressed in Mbh (1,000 Btu's per hour). Thus, a room with a heat loss of 5,800 Btu's per hour would lose 5.8 Mbh—the amount of heat that it is necessary to provide, in order to maintain the desired room temperature.

2

LAYING OUT THE SYSTEM

A piping layout, approximately to scale, is prepared next. It should be accurate enough to serve as an installation diagram, and be of help when pipe sizes are figured. Indicate on it the location of the boiler, compression tank, automatic feed and relief valve and all Convector-radiators. Also show location of the city water supply, other necessary valves and cocks and the pipe lengths.

Refer to Pages 20 and 21, on which Typical One-Pipe Layouts may be found, and select the piping arrangement best suited for the size and shape of the building you are designing.

3

SELECTING THE CONVECTOR-RADIATORS

(a) You already know the Mbh necessary to heat each room (Step 1).

(b) Choose the *average* water temperature at which the system will operate—180°, 190°, 200°, 210° or 215°.

(*Average* water temperature is the temperature of the water entering the Convector-radiator plus the temperature of the water leaving the Convector-radiator, divided by two. Therefore, to obtain an *average* water temperature of 200° in a Convector-radiator which has a temperature drop of 20°, the water must enter at 210° and leave at 190°. Accordingly, controls must be selected that are capable of maintaining the boiler water approximately 15° higher than the *average* water temperature.)

The *average* water temperature may be chosen by following the recommended design temperatures, which are:

200° . . . . . oil or gas-fired boilers
190° . . . . . stoker-fired boilers
180° . . . . . hand-fired boilers

(c) Then, starting with the room which the hot water from the boiler will heat first, select the proper size Convector-radiator from Convector Bulletin DSB 380, making use of Type A sizes where possible. (Use the table based on the *average* water temperature you have selected for your system.)

(d) Because the water to each Convector-radiator is returned again to the main, by a Trane Flo Fitting (Page 6), the water supplied to each succeeding Convector-radiator will be slightly lower in temperature than the water in the preceding one. While this reduction in water temperature is slight, it is advisable to take it into account.

This is done by giving the last Convector-radiator, in any one circuit, a Mbh capacity approximately 10% higher than the actual calculated loss in Mbh.

(e) Therefore, the first Convector-radiator should have a Mbh capacity very close to the actual heat loss calculation. The capacity should then be gradually increased, as each succeeding Convector-radiator is sized, until an increase of approximately 10% is reached when the selection of the last Convector-radiator in the circuit is made.

4

SELECTING THE PROPER SIZE CIRCULATOR

To select the proper size Trane Circulator it is necessary to calculate the gpm (gallons per minute) that the circulator will be required to handle.

Then, the correct size can be determined by using the Performance Curves Chart for Trane Circulators, which appears on Page 17.

The procedure is as follows:

(a) Figure the total Mbh loss of all the rooms in the building that is to be heated (Step 1).

(b) Substitute the total Mbh loss in this formula—

$$\text{gpm} = \frac{\text{Total Mbh of System}}{10.0}$$

(The factor "10" in the above formula is based on a temperature drop through the system of 20°F. and is established as follows: 8.33 (lbs of water per gal.) × 60 (min./hr.) × 20° = 10,000 Btu or 10 as we are dealing in Mbh.)

(c) Next, select the proper size Trane Circulator from the Performance Curves Chart on Page 17.

Normally, the circulator should be selected for a total head ranging from between eight and eleven feet of water to achieve the most economical combination of circulator and main size.

For example—

Referring to Figure 36, Page 15
Total Mbh of system = 106.1

$$\frac{106.1}{10.0} = 10.6 \text{ gpm}$$

According to the Performance Curves Chart on Page 17, a 1″ circulator will deliver 10.6 gpm against an 11′ head. Therefore, this is the proper Trane Circulator size to choose for the job.

5

PIPE SIZING FOR ANY TRANE ONE-PIPE HOT WATER SYSTEM

(A) Determining the Total Equivalent Length of Pipe

The Total Equivalent Length of Pipe is the sum of the measured length of piping in the longest circuit of a system, and the total equivalent length of the fittings, valves, etc.

For the average One Pipe Hot Water System—not requiring long runs of piping or an unusual number of fittings—the Total Equivalent Length of Pipe may be calculated, accurately enough for practical purposes, by multiplying the measured length of piping by 1.5.

Where extreme accuracy is desirable, due to the complexity of the system, the Total Equivalent Length of Pipe is determined as follows:

(1)

Using the piping layout prepared in Step 2, measure in feet the actual path taken by the water—from the boiler, through the longest main and back to the boiler (exclude branches, risers and Convector-radiators—figure main only).

(2)

To this measured length must be added the equivalent length of the various fittings, valves, etc., in the circuit. The

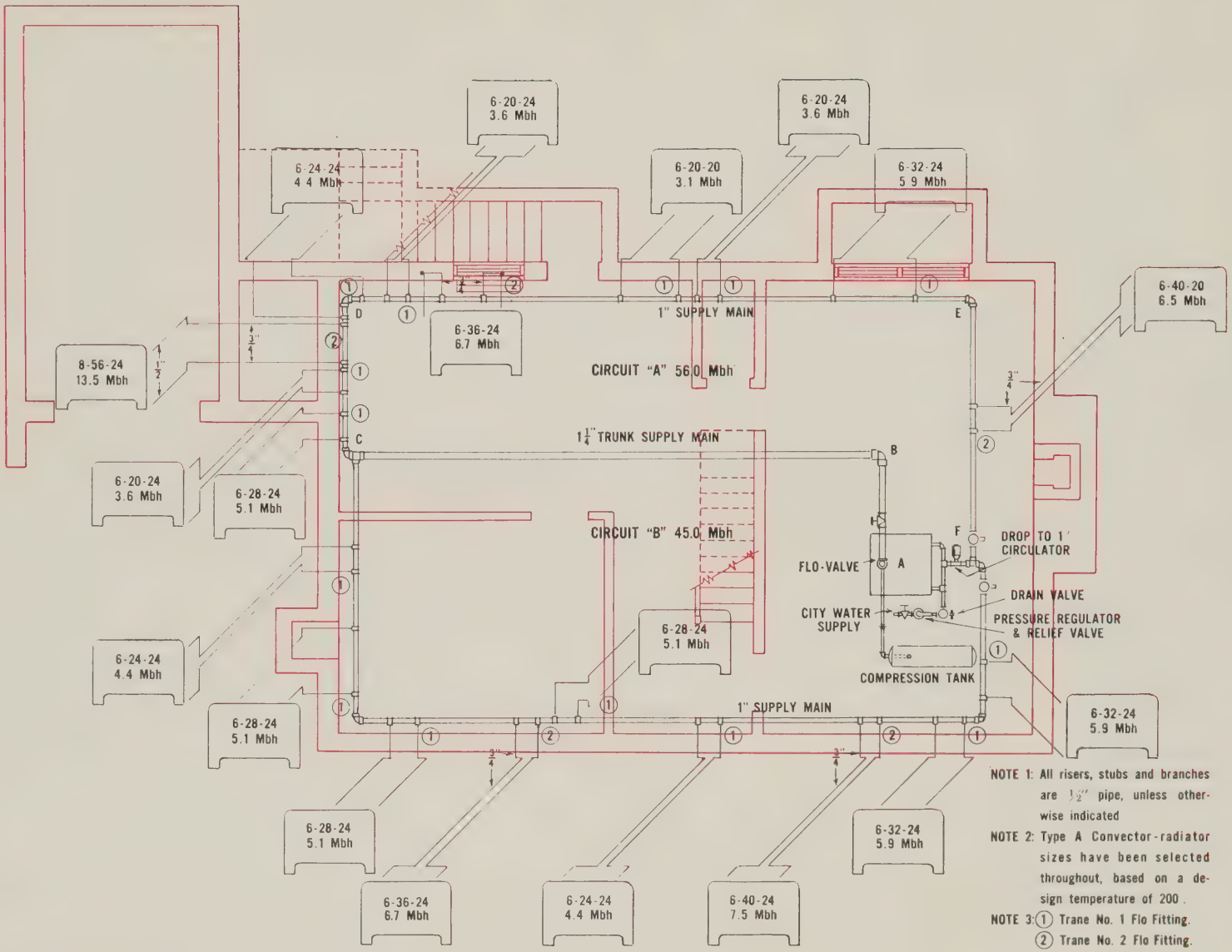


FIGURE 35—Layout for a Trane One-Pipe Hot Water System

equivalent length of the fittings normally encountered will be found in table 8 on Page 17.

The equivalent lengths of the flo fittings and the tees to the supply branches are accounted for later in the pipe sizing procedure and, therefore, are not taken into account in figuring the Total Equivalent Length of Pipe.

(3)

For Example—

Referring to Figure 35, Page 11, Circuit "A."

1 Boiler	9	ft. of Equivalent Length
7 90° Elbows	21	" " " "
1 45° Elbow	1.5	" " " "
1 Gate Valve	1	" " " "
1 Flo Valve	16	" " " "
1 Square Head Cock	3	" " " "
1 Tee-Side Outlet	6	" " " "
2 Tee-Runs	4	" " " "
Total Equivalent Length of Fittings	61.5	ft.
Measured Length of Pipe	97	ft.
Total Equivalent Length of Pipe	158.5	ft.

(B) Determining Available Head

To determine the available head on which to size the pipe, the loss of head caused by the Flo Fittings must first be figured.

Table 10 on Page 17 (Approximate Friction of Flo Fittings) gives the loss of head for the 3 types of Flo Fittings.

The loss of head must be totaled for all the Flo Fittings in any one complete circuit.

For Example—

Referring to Figure 35, Page 11, Circuit "A".

There are ten Convector-radiators, each using a Flo Fitting. The design temperature for the system is 200°.

According to Table 9, Page 17, all first floor Convector-radiators under 56″ in length and under 8.0 Mbh, and all second floor Convector-radiators under 48″ in length and under 6.5 Mbh, will use No. 1 Flo Fittings. The remainder will use No. 2 Flo Fittings.

Therefore, there will be three No. 2 Flo Fittings and seven No. 1 Flo Fittings.

7 No. 1 Flo Fittings at .35=2.45	
3 No. 2 Flo Fittings at .45=1.35	
Total Loss of Head due to Flo Fittings	3.8

The available head in feet is now obtained by deducting this Total Loss of Head due to Flo Fittings from the total head obtained from the Circulator Performance Curves in Step 4.

For Example—

Referring to Figure 35, Page 11.

Total Head	11.0
Loss of Head due to Flo Fittings	3.8
Available Head	7.2

(C) Determining the Allowable Friction per Foot of Pipe

The allowable friction per foot of pipe is determined by dividing the available head in feet by the total equivalent length of pipe.

For Example—

$$\frac{7.2 \text{ Available Head ("B" above)}}{158.5 \text{ Total Equivalent Length of Pipe}} = .045 \text{ feet of water per lineal foot}$$

(D) Sizing the Pipe

Using the friction per foot of pipe (obtained in "C"—above), the sizes for iron or steel pipe may be obtained from Chart 2 on Page 18 and for copper pipe from Chart 3 on Page 19.

All mains in the system are sized from these charts.

Risers are sized from the Flo Fitting Performance, Table 9, Page 17.

Water velocities of between 2′ and 4′ per second are recommended. The velocity should not greatly exceed 4′ per second or objectionable noise may result, but should be as close to this as possible.

For Example—

Referring to Figure 35, Page 11.

(1) *Sizing the Main:* From the Chart for iron and steel pipe on Page 18 we find that, with a friction of .045 feet of water per foot of pipe and with a total Mbh of 101.0, we can use a 1¼″ trunk main and 1¼″ circulator.

NOTE: While the point falls between the 1″ line and the 1¼″ line it is necessary to choose the larger size, so the friction loss will not exceed that already obtained.

Similarly, Branch Main CDEF in Circuit "A", carrying 56.0 Mbh and with a Friction of .045, will require a 1″ main.

In sizing the Branch Main for Circuit "B", the same friction that was figured for Circuit "A" is used. Circuit "B" carries a total of 45.0 Mbh, therefore, reference to Chart 2, Page 18 will show that the proper main size for this circuit is also 1″.

Should the velocity through the mains fall below 2′ per second, due to the allowable friction per foot of pipe being low, select a circulator with a higher head. This is done in order to increase the allowable friction per foot and to reduce the main size, thereby increasing the velocity to above 2′ per second.

(2) *Sizing the Branches and Risers:* Risers are automatically sized when the Flo Fitting selection is made for each Convector-radiator, since Table 9, Page 17 gives the characteristics of the various Flo Fittings when used with given riser sizes.

All Convector-radiators using No. 1 Flo Fittings will have ½″ run-outs and risers.

All Convector-radiators using No. 2 Flo Fittings will have ½″ or ¾″ run-outs and risers, depending on the Convector-radiator length and capacity, as shown in the Table on Flo Fitting Performance.

DESIGNING A TRANE TWO-PIPE HOT WATER SYSTEM

A Simplified, 5 Step Procedure for Designing Trane Two - Pipe Forced Hot Water Heating Systems.

The following design procedure is in accord with the latest improved engineering practice. Adherence to the method outlined in these steps will assure you of a balanced system correctly designed. The calculations and tables are for Trane Systems using Trane Convector-radiators.

1

DETERMINING THE TOTAL HEAT LOSS

Determining the number of Btu's lost in each room per hour (the heat loss of the room) gives the amount of heat (Btu's) that will have to be replaced—if the room is to be kept at a predetermined temperature.

This is done by calculating the heat loss of each room, in Btu's per hour, by one of the standard methods.

Then, to facilitate further calculations, the Btu's per hour are divided by 1,000 so the heat loss will be expressed in Mbh (1,000 Btu's per hour). Thus, a room with a heat loss of 5,800 Btu's per hour would lose 5.8 Mbh—the amount of heat that it is necessary to provide in order to maintain the desired room temperature.

2

LAYING OUT THE SYSTEM

A piping layout, approximately to scale, is prepared next. It should be accurate enough to serve as an installation diagram, and be of help when pipe sizes are figured. Indicate on it the location of the boiler, compression tank, automatic feed and relief valve and all Convector-radiators. Also, show location of the city water supply, other necessary valves and cocks and the pipe lengths.

Refer to Pages 21 and 22, on which typical Two-Pipe Layouts may be found, and select the piping arrangements best suited for the size and shape of the building you are designing.

A reverse return system is preferable because the circuit of each Convector-radiator is of equal length, eliminating many problems of unequal distribution of hot water through the system.

3

SELECTING THE CONVECTOR-RADIATORS

(a) You already know the Mbh necessary to heat each room (Step 1).

(b) Choose the *average* water temperature at which the system will operate—180°, 190°, 200°, 210°, or 215°.

(*Average* water temperature is the temperature of the water entering the Convector-radiator plus the temperature of the water leaving the Convector-radiator, divided by two. Therefore, to obtain an *average* water temperature of 200° in a Convector-radiator which has a temperature drop of 20°, the water must enter at 210° and leave at 190°. Accordingly, controls must be selected that are capable of maintaining the boiler water approximately 15° higher than the *average* water temperature.)

The *average* water temperature may be chosen by following the recommended design temperatures, which are:

200° . . . . . oil or gas-fire boilers
190° . . . . . stoker-fired boilers
180° . . . . . hand-fired boilers

(c) Then, select the proper size Convector-radiator for each room from Convector Bulletin DSB 380, making use of Type A sizes where possible. (Use the table based on the *average* water temperature you have selected for your system.)

4

SELECTING THE PROPER SIZE CIRCULATOR

To select the proper size Trane Circulator it is necessary to calculate the gpm (gallons per minute) that the circulator will be required to handle.

Then, the correct size can be determined by using the Performance Curves Chart for Trane Circulators which appears on Page 17.

(a) Figure the total Mbh loss of all rooms in the building that is to be heated (Step 1).

(b) Substitute the total Mbh loss in this formula—

$$\text{gpm} = \frac{\text{Total Mbh of System}}{10.0^*}$$

(*The factor "10" in the above formula is based on a temperature drop through the system of 20° F. and is established as follows: 8.33 (lbs. of water per gal.) × 60 (min./hr.) × 20° F. = 10,000 Btu or 10, as we are dealing in Mbh.)

(c) Next, select the proper size Trane Circulator from the Performance Curves Chart on Page 17.

Normally, the circulator should be selected for a total head ranging between eight and eleven feet of water to achieve the most economical combination of circulator and main size.

For Example—

Figure 36, Page 15.

Total Mbh of system = 107.1

$$\frac{107.1}{10.0} = 10.7 \text{ gpm}$$

According to the Performance Curves Chart on Page 17, a 1" Circulator will deliver 10.7 gpm against an 11.0' head. Therefore, this is the proper size Trane Circulator to choose for the job.

If, in this range, there is a choice of two sizes of circulators, the selection of the larger size may result in a greater overall economy, a result of the reduction in the main size. This may be determined by comparing the circulator and piping costs of the smaller size with the next larger size.

5

SELECTING THE CORRECT PIPE SIZES

(A) Determining the Total Equivalent Length of Pipe

The Total Equivalent Length of Pipe is the sum of the measured length of piping in the longest circuit of a system, and the total equivalent length of the fittings, valves, etc.

It is determined as follows:

(1)

Using the piping layout prepared in Step 2, measure in fect the actual path taken by the water—from the boiler, through the longest circuit and back to the boiler, including the supply main, supply run-outs and risers to the Convector-radiators, return risers and run-outs from the Convector-radiators and the return main back to the boiler.

(2)

To this measured length must be added the equivalent length of the various fittings, valves, etc. *All the fittings in the entire measured circuit are included.* The equivalent lengths for fittings normally encountered will be found in table 8 on Page 17.

(3)

For Example—

Referring to Figure 36, Page 15, Circuit "A".

1 Boiler	9	ft. of	Equivalent Length
11 90° Elbows	33	" "	" "
3 45° Elbows	4.5	" "	" "
1 Gate Valve	1	" "	" "
1 Flo Valve	16	" "	" "
1 Square Head Cock	3	ft. of	Equivalent Length
1 Straightway Convector-radiator Valve	3	" "	" "
1 Standard Tee-Side Outlet	6	" "	" "
13 Standard Tee-Runs	26	" "	" "
Equivalent Length of Fittings	101.5	ft.	
Measured Length	111.0		
Total Equivalent Length of Pipe	212.5	ft.	

(B) Determining Available Head

Deduct from the total head, obtained from the Circulator Performance Curves in Step 4, the friction due to the longest Convector-radiator in the circuit. This is done to determine the available head on which to size the piping.

For Example—

Referring to Figure 36, Page 15, the longest Convector-radiator is 8" x 56" long x 24" high, with a capacity of 13.5 Mbh. From Table 11 it will be found that the water friction through this Convector-radiator is .071 feet of water. Therefore:

11.0
.071
10.929 Feet of Available Head

(C) Determining the Allowable Friction per Foot of Pipe

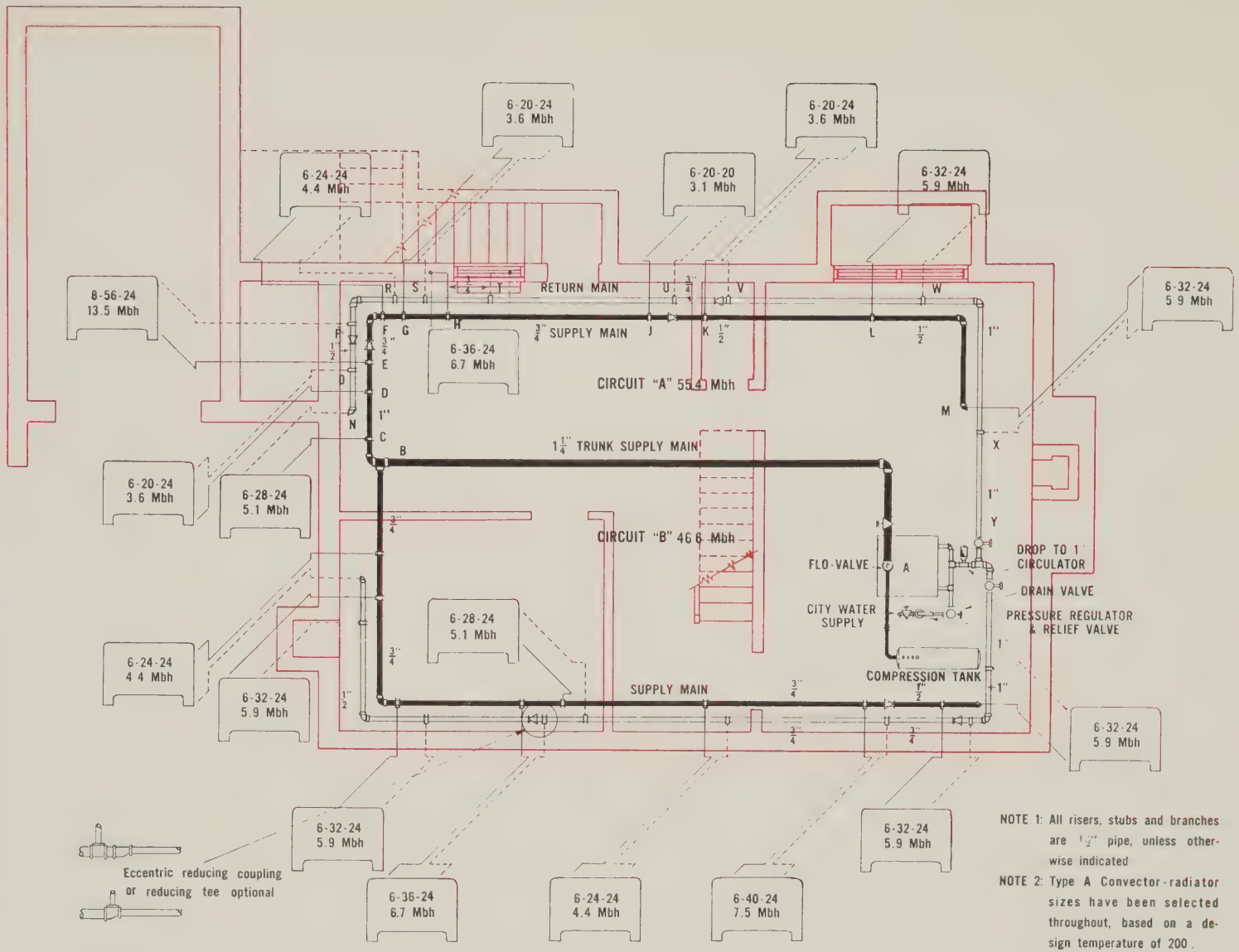


FIGURE 36—Layout for a Trane Two-Pipe System

The allowable friction per foot of pipe is determined by dividing the available head in feet by the Total Equivalent Length of Pipe.

For Example—

Referring to Figure 36, Page 15.

$$\frac{10.929 \text{ Available Head ("B" above)}}{212.5 \text{ Total Equivalent Length of Pipe}} = .051 \text{ feet of water per lineal foot}$$

(D) Sizing the Pipe

Using the friction per foot of pipe (obtained in "C" above), the sizes for iron or steel pipe may be obtained from Chart 2 on Page 18 and for copper pipe from Chart 3 on Page 19.

All piping in the system is sized from these charts.

Water velocities of between 2′ and 4′ per second are recommended. The velocity should not greatly exceed 4′ per second or objectionable noise may result, but should be as close to this as possible.

Starting at the boiler, size the supply main first, using the total Mbh.

Proceed around the system, decreasing the Mbh load on the main as each Convector-radiator run-out is taken off. Continue this until, at the last Convector-radiator, the supply main is the same size as required for that particular Convector-radiator.

Eccentric Reducing Couplings or Reducing Tees are optional for changing the main sizes.

To size the return, start at the last Convector-radiator in the system, increasing the return main size as each Convector-radiator return run-out is added.

For Example—

Referring to Figure 36, Page 15.

Sizing the trunk supply main first, using the chart for iron or steel pipe, section AB carries 107.1 Mbh. From Chart 2, Page 18, it will be noted that at .051 friction the size of the pipe required to carry 107.1 Mbh falls between the 1″ and 1¼″ pipe lines. In order not to have a friction above .051, a 1¼″ pipe is necessary.

Similarly, Section BC, carrying 55.4 Mbh, requires a 1″ pipe as does Section CD, which carries 50.3 Mbh, and section DE, carrying 46.7 Mbh.

Section EF, carrying 33.2 Mbh; Section FG, carrying 28.8 Mbh; Section GH, carrying 25.2 Mbh; and Section HJ, carrying 18.5 Mbh all require ¾″ pipe.

The remainder of the supply main, Sections JK, KL and ML is ½″ pipe, which is the minimum allowable pipe size for iron or steel pipe.

Start at point N to size the return main, using the same friction (obtained in "C").

Section NO, carrying 5.1 Mbh and Section OP, carrying 8.7 Mbh, both require ½″ pipe.

Section PR, carrying 22.2 Mbh; Section RS, carrying 26.6 Mbh; Section ST, carrying 30.2 Mbh; Section TU, carrying 36.9 Mbh; Section UV, carrying 40 Mbh and Section VW, carrying 43.6 Mbh, all require ¾″ pipe.

Section WX, carrying 49.5 Mbh and Section XY, carrying 55.4 Mbh, both require 1″ pipe.

To size the risers, stubs and branches, use the same friction (.051 obtained in "C"), and, referring to the Chart on Page 18 for iron or steel pipe or to Page 19 for copper pipe, size the pipe according to the Mbh capacity of the individual Convector-radiators. (Where more than one Convector-radiator is served by one branch or riser, use the combined Mbh capacity up to the point where the piping splits.)

Supply and return branches and risers to Convector-radiators located below the main should be one size larger than standard.

For Example—

The maximum capacity of a ½″ pipe at .051 friction is 18 Mbh. All the Convector-radiators in this problem have a capacity less than 18 Mbh. Therefore, all branches, risers and run-outs will be of ½″ pipe, except for the 6.7 Mbh Convector-radiator which is located below the main. As piping to such downfeed Convector-radiators should always be one size larger than standard, it will require ¾″ pipe.

GENERAL NOTES

(Trane One- and Two-Pipe Hot Water Heating Systems)

FIGURE 37

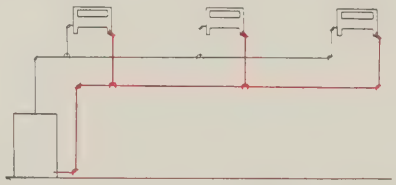


FIGURE 38

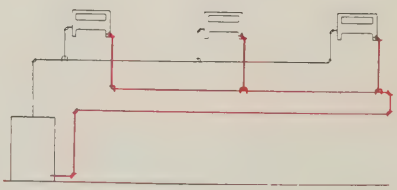


FIGURE 39

Figure 37 is a diagrammatic layout of a simple, single main (one-pipe) hot water system. Figure 38 shows a two-pipe, direct return system. Note that each Convector-radiator circuit is of a different length. Figure 39 illustrates a two-pipe, reverse return hot water system. In the reverse return system the length of the water circuit, from the boiler and through any one Convector-radiator, is practically the same as for any other Convector-radiator. The resultant equalized circuits mean that the friction and temperature losses of all Convector-radiators should be nearly the same.

On all Trane One- and Two-Pipe Systems the following should be observed: 1. Protect all exposed piping from freezing temperatures. 2. Provide drains at all low points in the piping. 3. All branches to risers should usually be taken off the top of the main at 45°. 4. All upfeed Convector-radiators should be equipped with air chambers.

On Trane Two-Pipe Systems, or where more than one Convector-radiator is served by a single Flo Fitting, balancing fittings should be installed in the return piping from each Convector-radiator.

In Trane One-Pipe Systems the distance between the supply tee and Flo Fitting in the supply main should be spaced not less than 3′0″ apart unless it is absolutely impossible to maintain this spacing, due to structural conditions on the job. When this spacing cannot be maintained, The Trane Company or its representative should be consulted.

CHART 1
PERFORMANCE CURVES OF TRANE CIRCULATORS

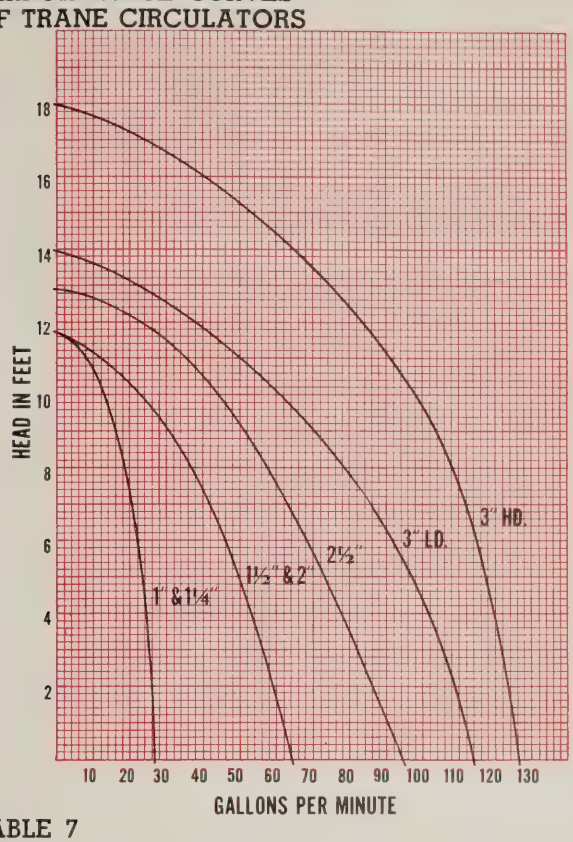


TABLE 7
AVAILABLE SIZES OF BRANCH CONNECTIONS

CAST IRON FLO FITTING	MAIN SIZE ¾"	1"	1¼"	1½"	2"	2½"
NO. 1	½" FOR ALL ABOVE MAIN SIZES					
NO. 2	½ & ¾" FOR ALL ABOVE MAIN SIZES					
NO. 3			1"	1"	1" & 1¼"	1" & 1¼"

CAST BRONZE FLO FITTING	MAIN SIZE ¾"	1"	1¼"	1½"	2"
NO. 1	½" FOR ALL ABOVE MAIN SIZES				
NO. 2	½" & ¾" FOR ALL ABOVE MAIN SIZES				
NO. 3			1"	1"	1" & 1¼"

TABLE 8
EQUIVALENT LENGTHS OF VALVES, BOILERS AND FITTINGS

TYPE OF FITTING	EQUIVALENT LENGTH IN FEET: IRON OR STEEL PIPE	COPPER PIPE
STANDARD ELBOW	3.0	3.0
45 DEGREE ELBOW	1.5	1.5
STANDARD TEE-RUN	2.0	2.0
STANDARD TEE-SIDE OUTLET	6.0	6.0
STANDARD TEE-RUN REDUCED HALF SIZE	3.0	3.0
ANGLE HOT WATER VALVE	6.0	9.0
STRAIGHTWAY BALANCING FITTING	3.0	3.0
ANGLE BALANCING FITTING	6.0	6.0
STRAIGHTWAY CONVECTOR VALVE	3.0	3.0
GATE VALVE (FULLY OPEN)	1.0	1.5
FLO VALVE	16.0	23.0
SQUARE HEAD COCK	3.0	4.0
BOILER	9.0	13.0

TABLE 9
FLO FITTING PERFORMANCE

FLO FITTING NO.	RISER SIZE	FIRST FLOOR MAX. CONV. LGTH.	FIRST FLOOR MAX. CONV. CAPACITY	SECOND FLOOR MAX. CONV. LGTH.	SECOND FLOOR MAX. CONV. CAPACITY	THIRD FLOOR MAX. CONV. LGTH.	THIRD FLOOR MAX. CONV. CAPACITY
1	½"	56"	8.0 MBH	48"	6.5 MBH	44"	5.5 MBH
2	½"	64"	12.0 MBH	56"	9.5 MBH	48"	8.0 MBH
	¾"	64"	23 MBH	64"	20 MBH	64"	18 MBH
3	1"	64"	36 MBH	64"	34 MBH	64"	32 MBH
	1¼"	64"	42 MBH	64"	41 MBH	64"	40 MBH

NOTE 1: IN NO CASE SHOULD EITHER THE CONVECTOR-RADIATOR LENGTH OR THE MBH CAPACITY BE GREATER THAN THE VALUE GIVEN IN THE ABOVE TABLE FOR ANY ONE FLO FITTING.

NOTE 2: WHENEVER CONVECTOR-RADIATORS ARE LOCATED BELOW THE MAIN, MAKE BRANCHES RISERS ONE SIZE LARGER THAN STANDARD. THE MAXIMUM LENGTH OF SUCH CONVECTOR-RADIATORS SHOULD BE 48". SHORTER CONVECTOR-RADIATORS ARE RECOMMENDED.

TABLE 10
APPROXIMATE FRICTION OF FLO FITTINGS FOR DETERMINING LOSS OF HEAD

FITTING NO. 1	.35	FRICTION, FEET OF WATER
FITTING NO. 2	.45	" " " "
FITTING NO. 3	.75	" " " "

TABLE 11
WATER FRICTIONS THROUGH TRANE CONVECTOR-RADIATORS EXPRESSED IN FEET OF WATER

REFERENCE LENGTHS	REFERENCE DEPTHS 4"	6"	8"	10"
16"	.005 FT.	.003 FT.	.003 FT.	.003 FT.
20"	.008 FT.	.006 FT.	.005 FT.	.005 FT.
24"	.012 FT.	.010 FT.	.008 FT.	.008 FT.
28"	.017 FT.	.015 FT.	.012 FT.	.011 FT.
32"	.022 FT.	.021 FT.	.017 FT.	.015 FT.
36"	.029 FT.	.027 FT.	.023 FT.	.021 FT.
40"	.036 FT.	.035 FT.	.030 FT.	.027 FT.
44"	.045 FT.	.045 FT.	.039 FT.	.034 FT.
48"	.055 FT.	.056 FT.	.048 FT.	.042 FT.
56"	.078 FT.	.083 FT.	.071 FT.	.061 FT.
64"	.105 FT.	.114 FT.	.101 FT.	.085 FT.

TABLE 12
COMPRESSION TANK CAPACITIES

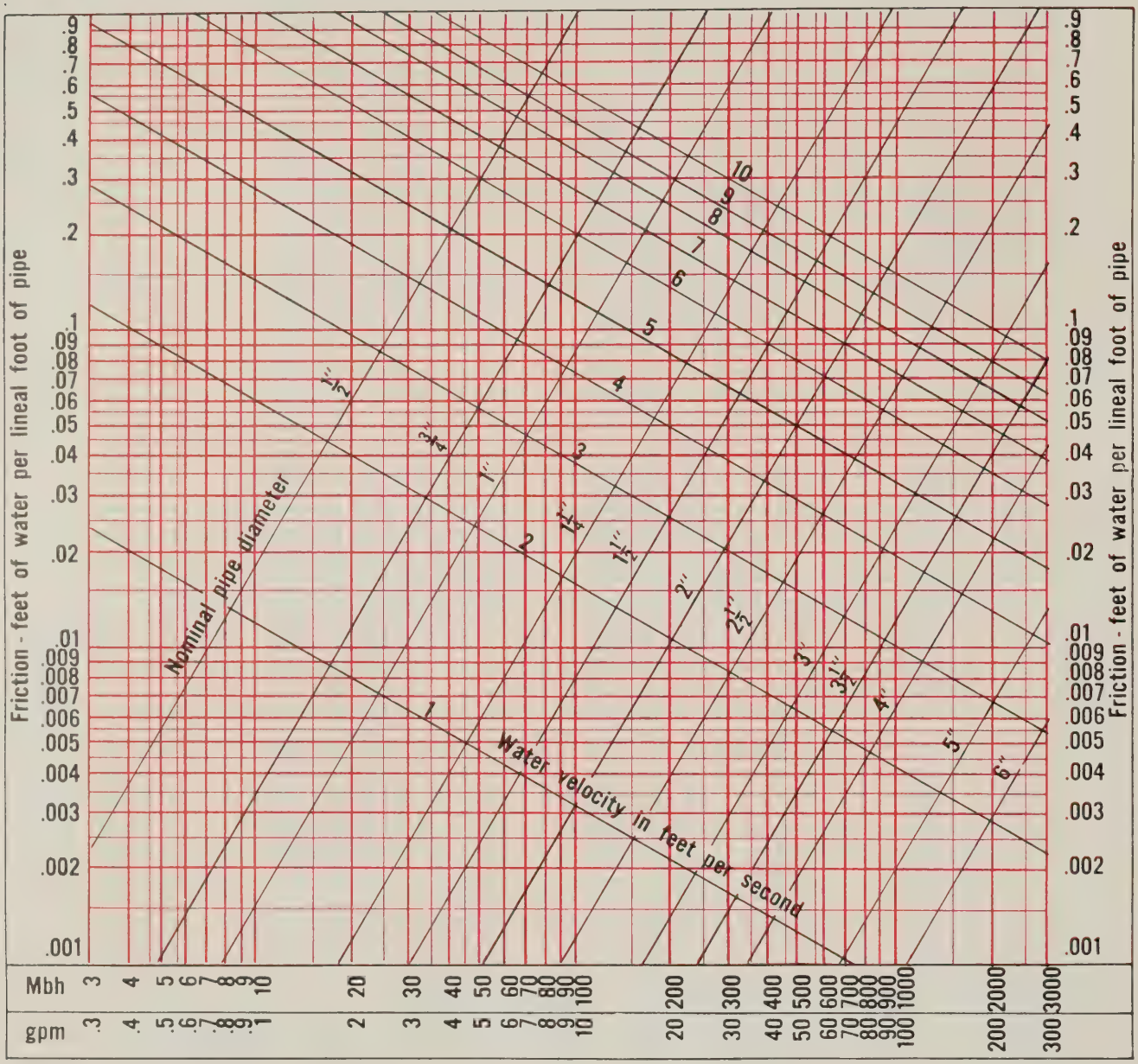
TOTAL MBH OF SYSTEM	TANK CAPACITY	TANK SIZE	APPROX. WEIGHT	TAPPING SIZE
UP TO 60	15 GALLONS	12 X 30	40 LBS.	½"
61 TO 105	18 "	12 X 36	45 "	½"
106 TO 195	24 "	12 X 48	55 "	½"
196 TO 270	30 "	12 X 60	65 "	½"
271 TO 420	40 "	14 X 60	75 "	½"
421 TO 540	60 "	TWO 12 X 60	130 "	½"
541 TO 720	80 "	TWO 14 X 60	168 "	½"

THE ABOVE TANK CAPACITIES ARE BASED ON WATER VOLUMES AS FOUND IN SYSTEMS USING NON-FERROUS CONVECTOR-RADIATORS. IF CAST IRON CONVECTOR-RADIATORS OR RADIATORS ARE USED, TANKS MUST BE LARGER. (SEE A.S.H. & V.E GUIDE FOR RECOMMENDED SIZES.)

CHART 2

CARRYING CAPACITY AND FRICTION LOSS OF HEAD FOR

IRON OR STEEL PIPE



NOTE: MBH AND GPM ARE BASED ON A 20 DEGREE TEMPERATURE DROP.

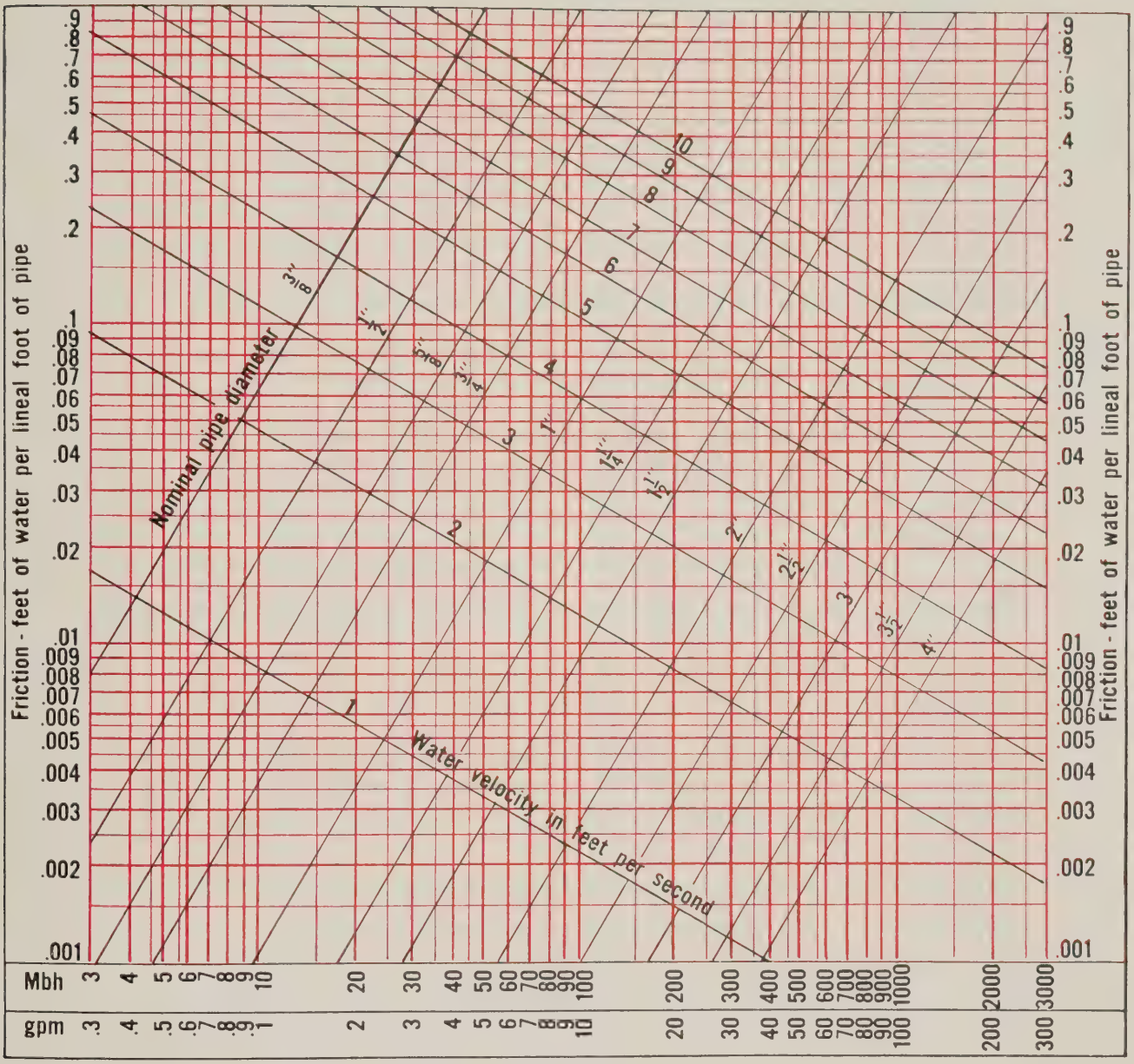
The above chart is used for determining the size of all the iron or steel pipe that is to be used in Trane One-Pipe or Two-Pipe Forced Hot Water Heating Systems. (See Page 12 of the Design Procedure for Trane One-Pipe Hot Water Systems and Page 16 of the Design Procedure for Trane Two-Pipe Hot Water Systems.) Water velocities of between two and four feet per second are recommended for both types of systems. The velocity should not greatly exceed four feet per second or objectionable noise may result. However, it should be as close to this figure as possible.

Pipe sizes below one-half inch are not recommended for iron or steel pipe and, therefore, are not shown on this chart.

CHART 3

CARRYING CAPACITY AND FRICTION LOSS OF HEAD FOR

COPPER PIPE



NOTE: MBH AND GPM ARE BASED ON A 20 DEGREE TEMPERATURE DROP

The above chart is used for determining the size of all the copper pipe that is to be used in Trane One-Pipe or Two-Pipe Forced Hot Water Heating Systems. (See Page 12 of the Design Procedure for Trane One-Pipe Hot Water Systems and Page 16 of the Design Procedure for Trane Two-Pipe Hot Water Systems.) Water velocities of between two and four feet per second are recommended for both types of systems. The velocity should not greatly exceed four feet per second or objectionable noise may result. However, it should be as close to this figure as possible.

The above chart is only approximate, in that little actual data is available on the flow of water through copper pipe.

PIPING LAYOUTS

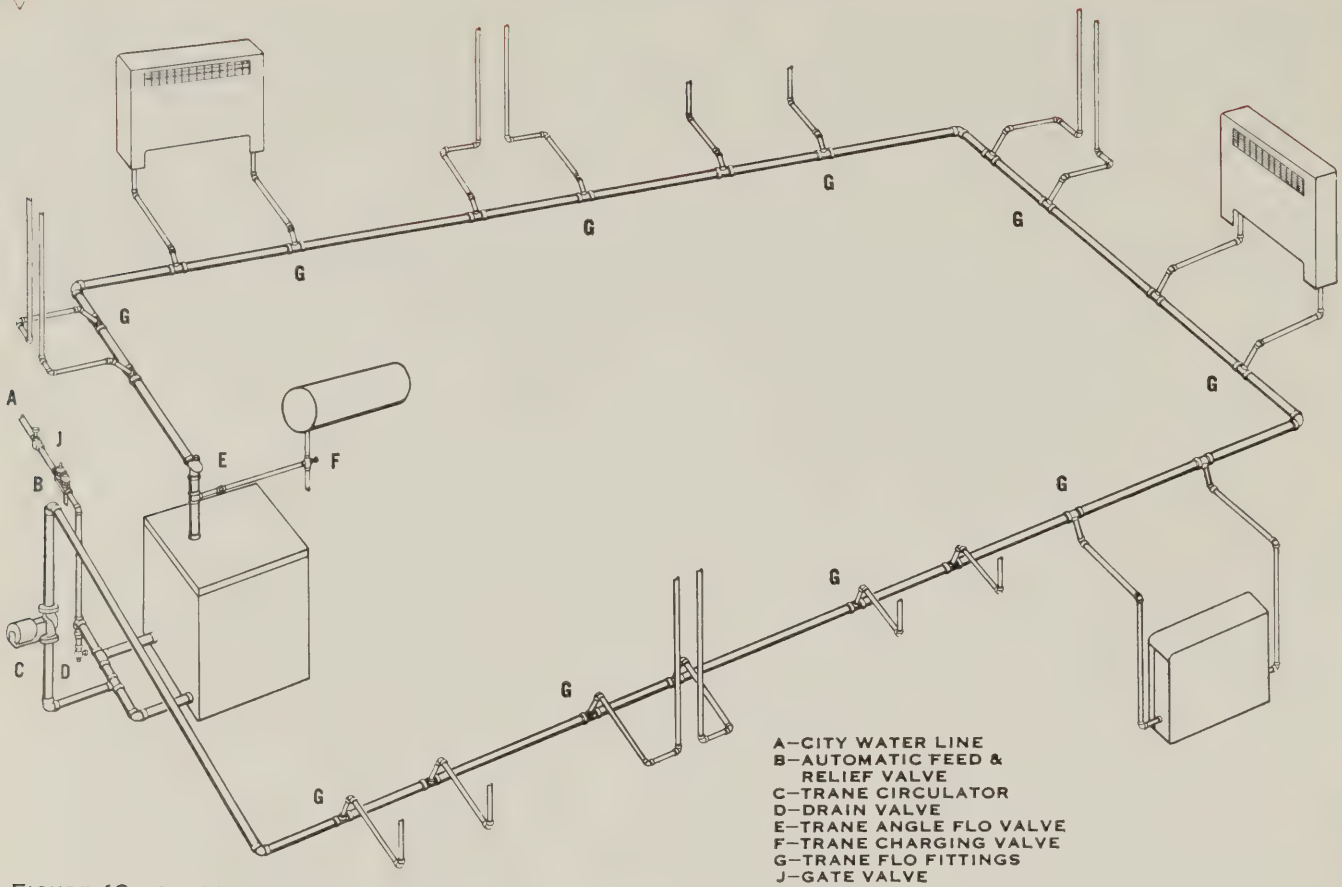


FIGURE 40—One Pipe Single Circuit System

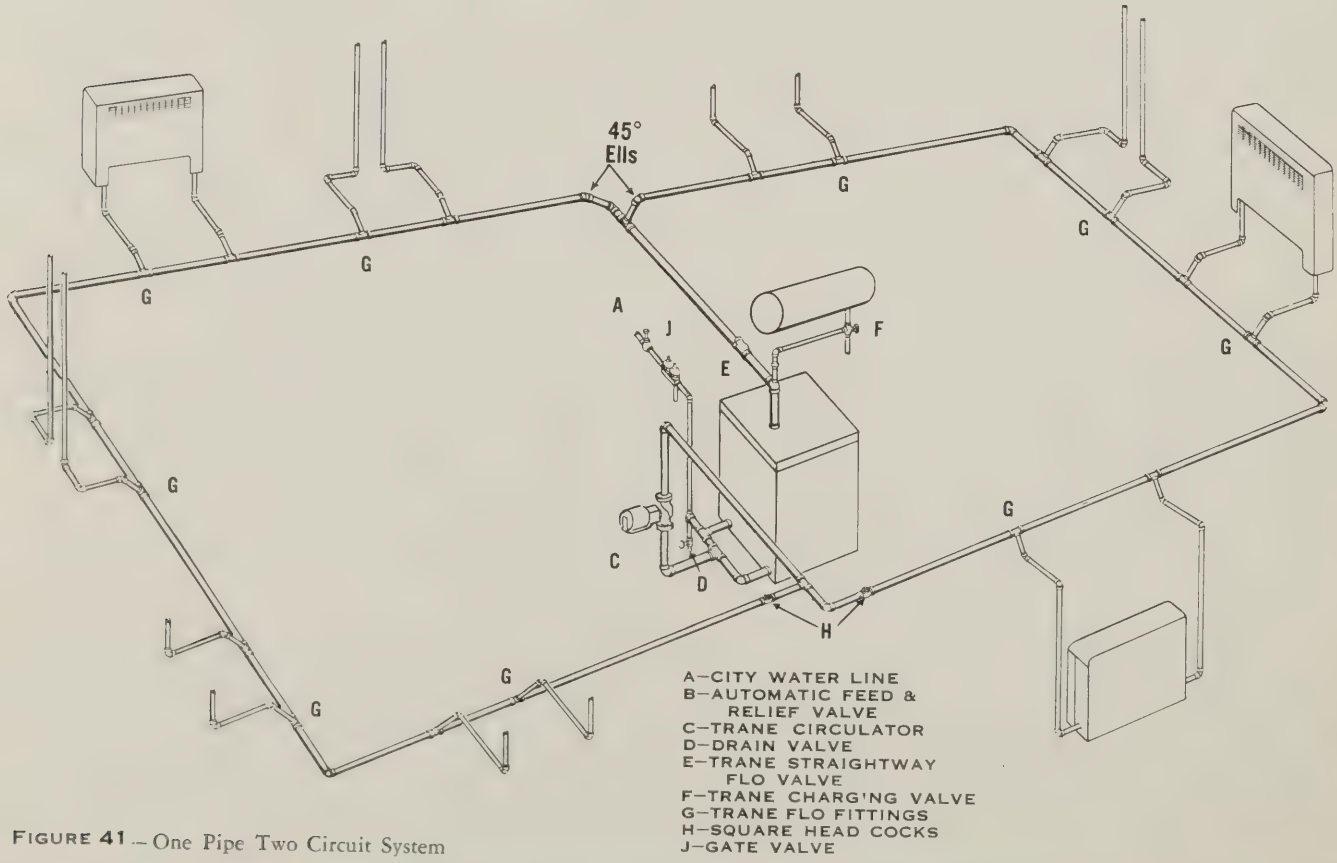


FIGURE 41—One Pipe Two Circuit System

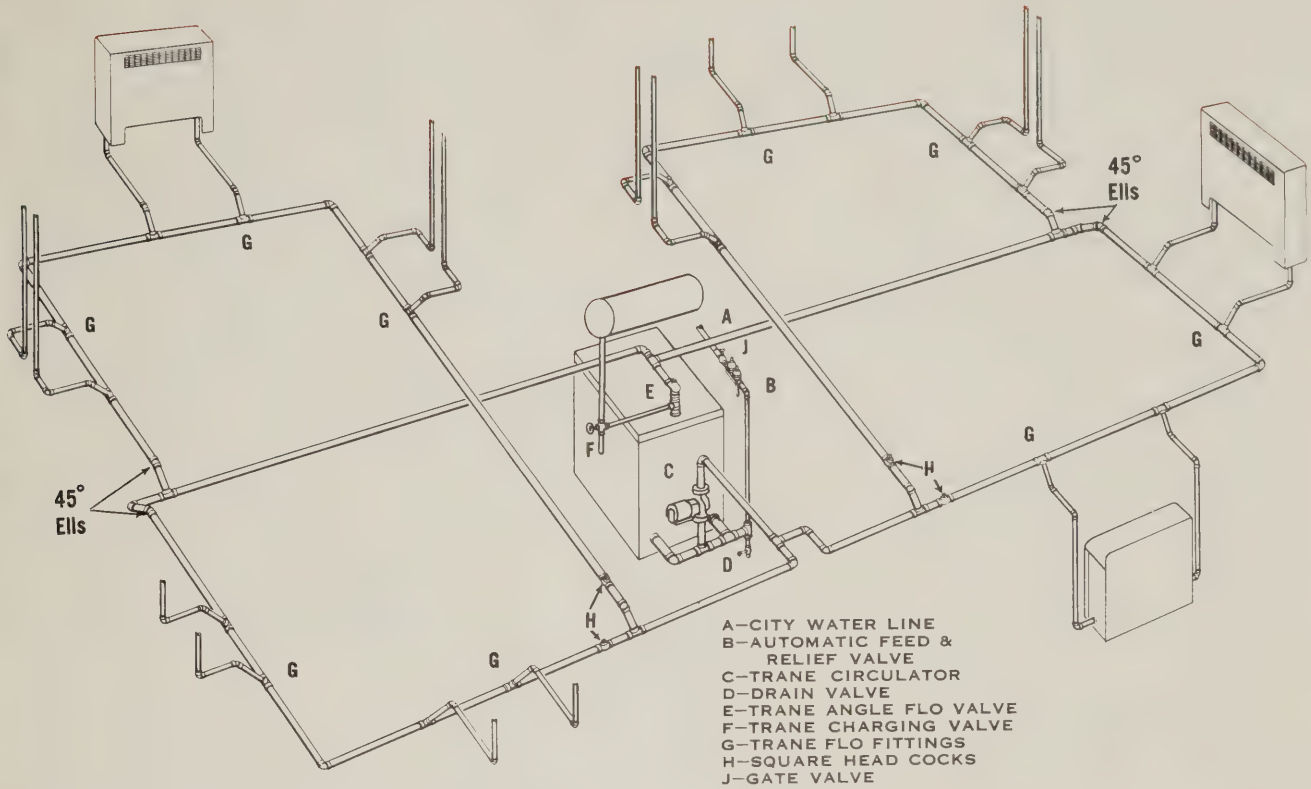


FIGURE 42—One Pipe Four Circuit System

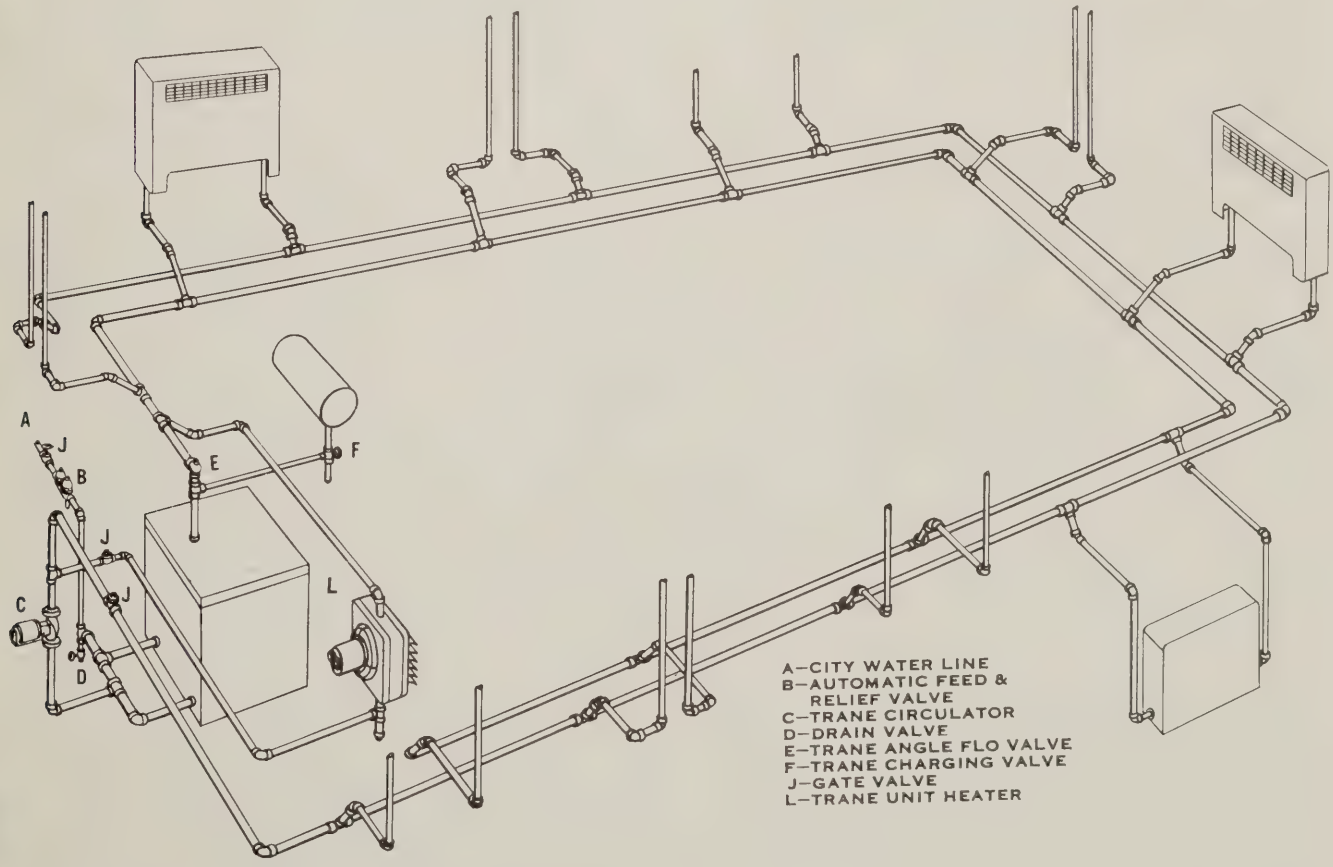


FIGURE 43—Two Pipe Single Circuit System

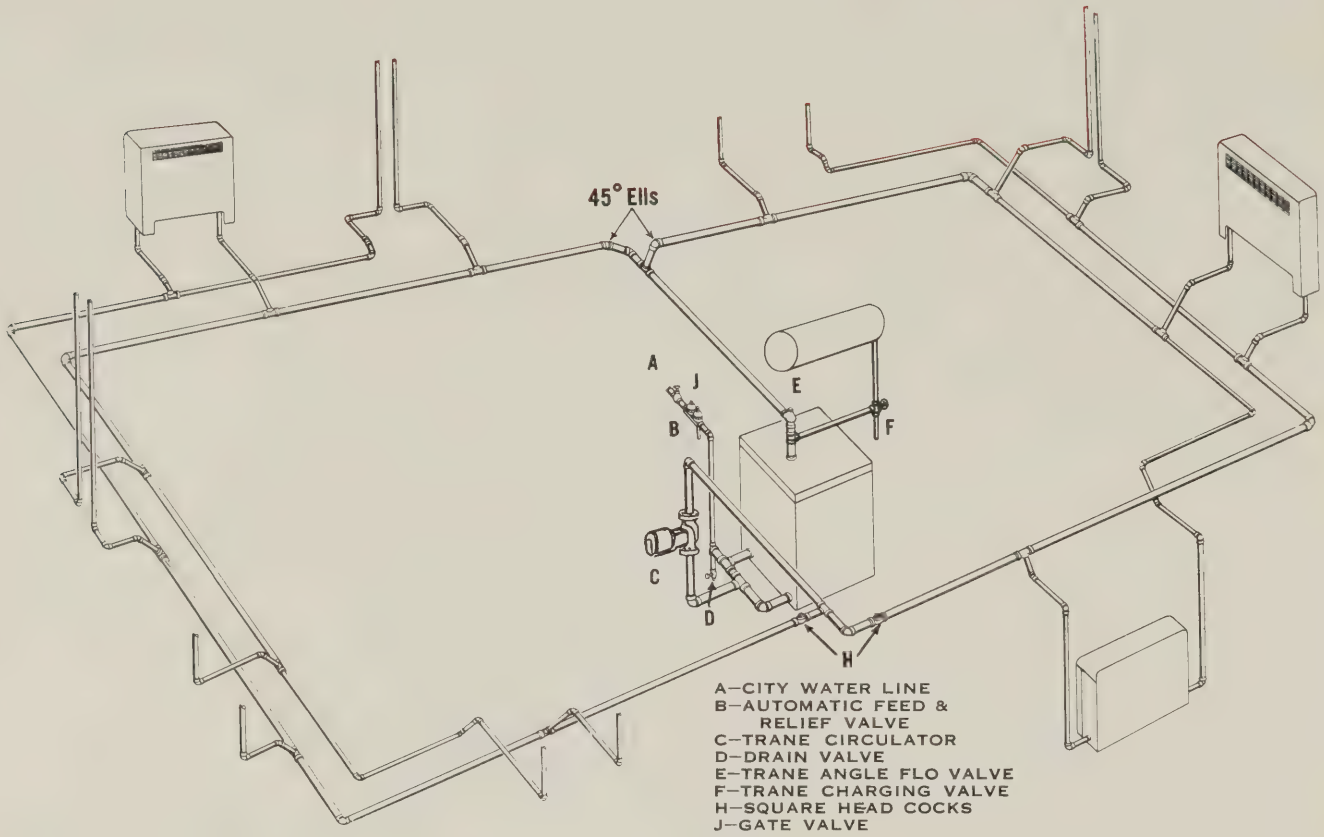


FIGURE 44—Two Pipe Two Circuit System

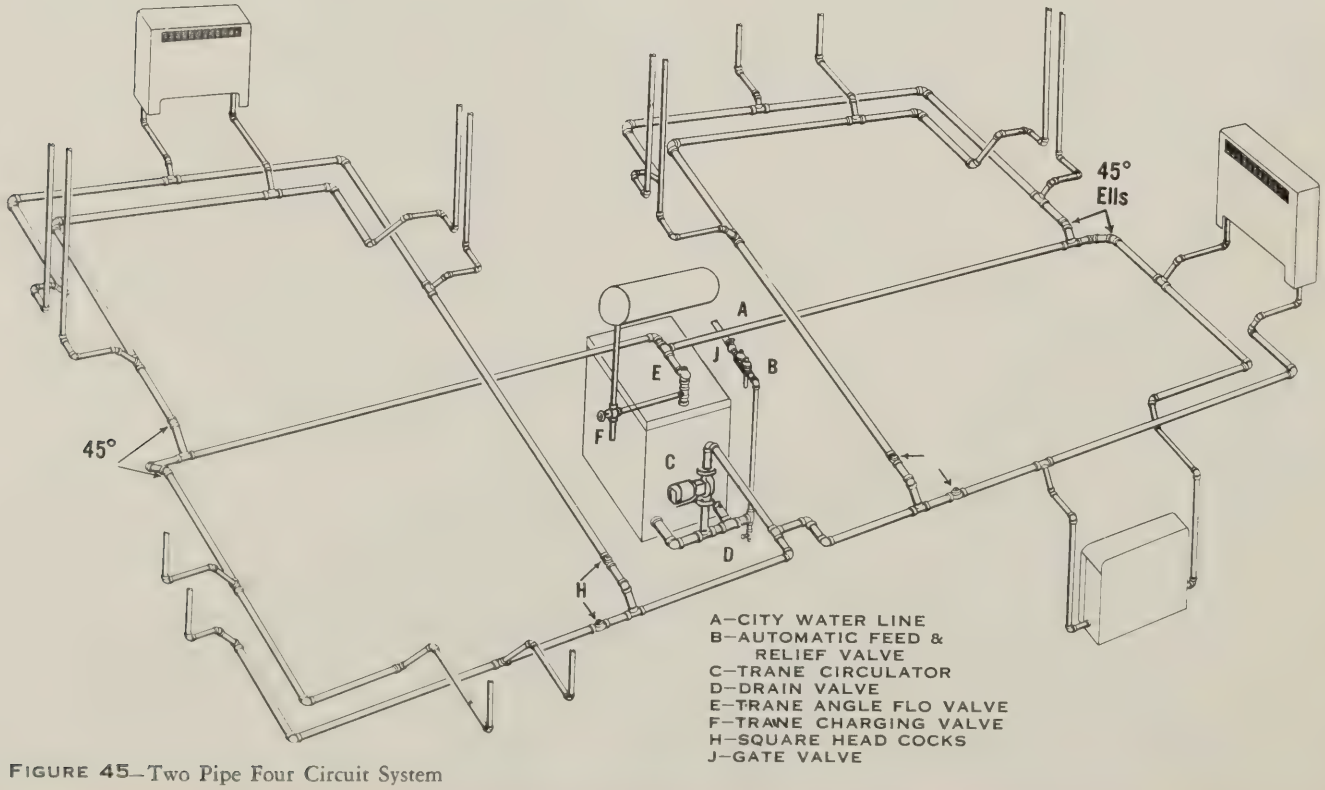
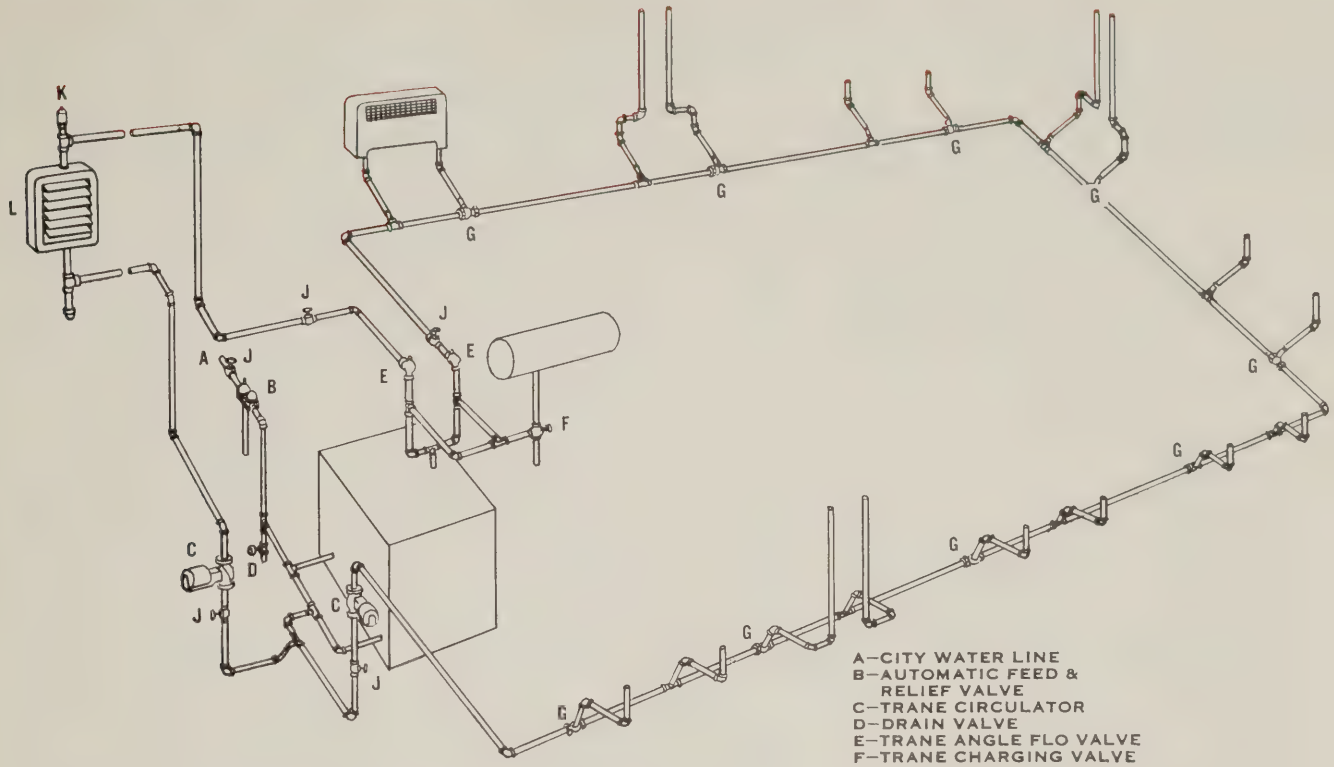


FIGURE 45—Two Pipe Four Circuit System



A—CITY WATER LINE
B—AUTOMATIC FEED & RELIEF VALVE
C—TRANE CIRCULATOR
D—DRAIN VALVE
E—TRANE ANGLE FLO VALVE
F—TRANE CHARGING VALVE
G—TRANE FLO FITTINGS
J—GATE VALVE
K—AUTOMATIC AIR VENT
L—TRANE UNIT HEATER

FIGURE 46—One Pipe Single Circuit System with Unit Heater for Garage

DETAIL OF PIPING TO CONVECTOR-RADIATORS LOCATED ABOVE MAIN

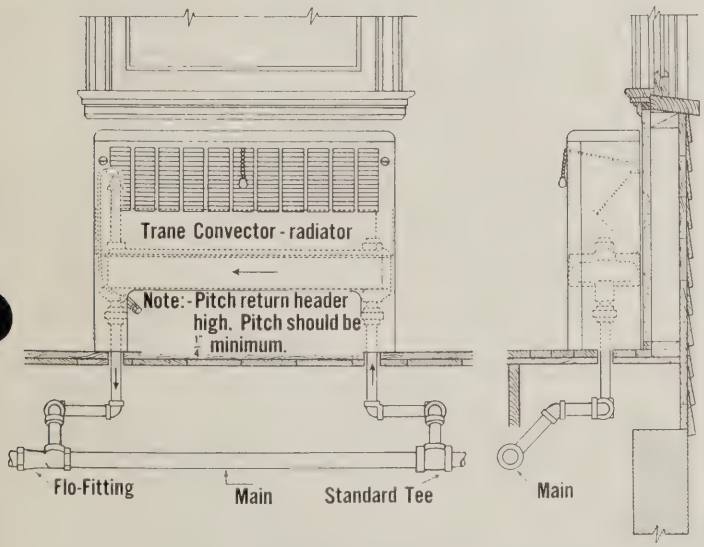


FIGURE 47

DETAIL OF PIPING TO CONVECTOR-RADIATORS LOCATED BELOW MAIN

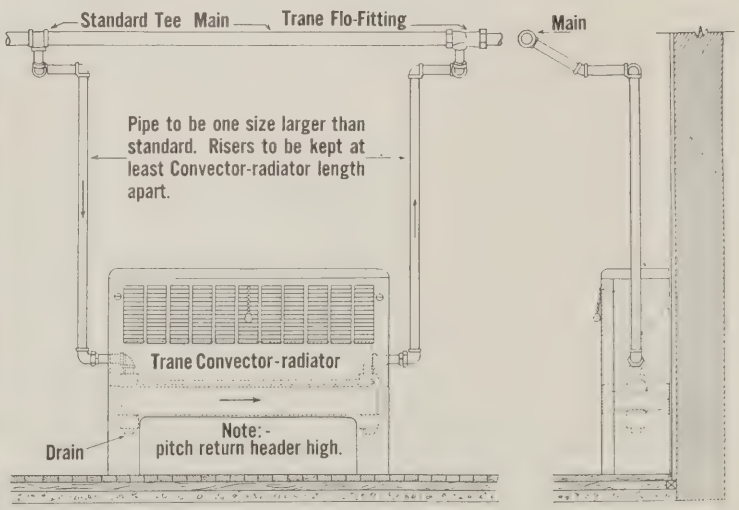


FIGURE 48

Suggested piping connections for Convector-radiators located above mains and below mains are shown above. Swing joints, to eliminate expansion and contraction noises and reduce strain on piping, are always recommended and branches should be taken off the main at a 45° angle, as shown. With Convector-radiators located below the main, piping must be so arranged that air will not be trapped in the element when the system is filled, and provision must be made for complete drainage. One method of accomplishing both is shown above. Branch and riser sizes for Convector-radiators located below the main should be larger than for Convector-radiators located above the main. Convector-radiators longer than 48″ should not be used below the main.

BOILER DETAILS

SUGGESTED DETAIL FOR A HOUSE WITHOUT A BASEMENT

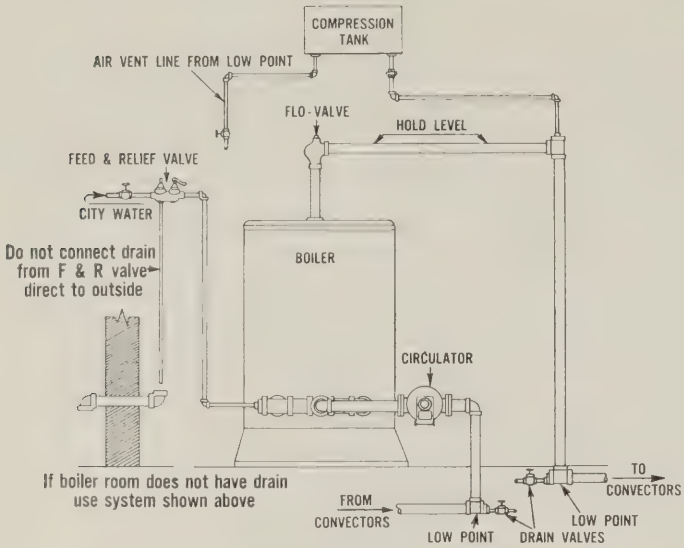


FIGURE 49

SUGGESTED DETAIL FOR AN OIL OR GAS-FIRED INSTALLATION

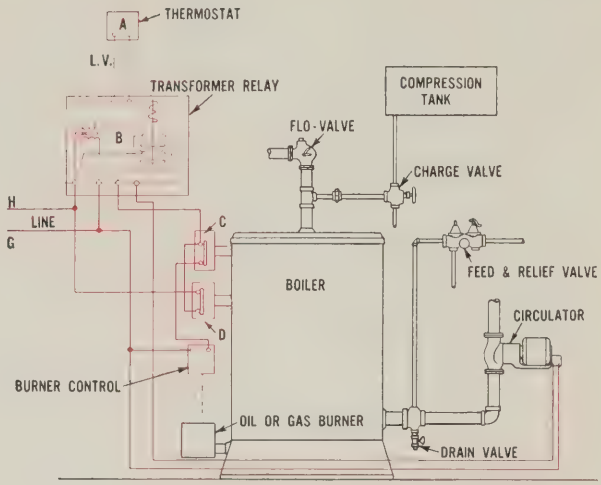


FIGURE 50

When the boiler is located on the first floor level of a house, special boiler piping treatment is necessary. By following the detail shown above, it is possible to effectively handle air elimination. However, the air vent valve should be opened occasionally to make sure the system is not air-bound. Or, a gauge glass may be installed on the compression tank to indicate when venting is necessary.

This piping arrangement may be used for both One-Pipe and Two-Pipe Systems.

Two-Pipe mains should have a definite pitch downward, toward the boiler.

One-Pipe mains should be run exactly level, or with a slight pitch downward, toward the boiler.

It is important for mains and run-outs to be well insulated in order to prevent any excessive heat loss to the floors.

Where the boiler room does not have a floor drain the small detail, at the left of the above piping detail, should be followed closely. This is a safety measure that is provided so that the relief drain line cannot freeze shut, preventing relief of excessive pressure.

Where there is insufficient room between the floor and the return tapping into the boiler to allow for the installation of the Trane Circulator in the vertical section of the main, the circulator must be installed in the horizontal section leading to the boiler return tapping or header, as is shown in the above piping detail. If this procedure proves necessary the motor and motor bracket of the Trane Circulator must be turned 90° after the circulator is installed in order to provide proper oiling to the bearings. To turn the motor and bracket of the Trane Circulator, remove four bolts in the circulator body and rotate the motor and bracket 90° so that the oil cups are in an up position. The bolts are then replaced.

Do not loop the piping above the return tapping of the boiler or air binding may result.

The thermostat, "A," which is of the low voltage type, calls for heat causing the transformer relay "B" to operate. This sends current to both the oil or gas burner and the circulator. In series with the burner is the high limit control "C", which would cut off the burner should the boiler temperature exceed a predetermined maximum water temperature. The high limit control "C" should be set 20° to 30° higher than the *design* water temperature of the heating system. Low limit control "D" maintains a predetermined boiler water temperature. An alternate arrangement would be to control the circulator solely by the room thermostat. If this is done, an immersion type control is installed in the boiler to maintain a predetermined temperature in the boiler at all times.

PIPING CONNECTIONS TO CONVECTOR-RADIATORS

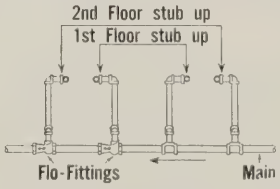


FIGURE 51
WRONG METHOD

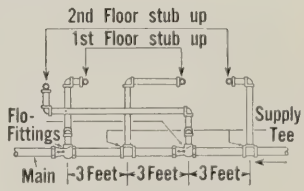


FIGURE 52
RIGHT METHOD

Care should be taken *not* to size the main too liberally, as a relatively low water velocity in the main will result. As the Trane Flo Fitting is designed for a water velocity of approximately 3 feet per second, decreased water velocity will result in a decreased induced flow of water through the Convector-radiator. *The water velocity in the main should approximate 3 ft. per second.*

The spacing between the Trane Flo Fittings and the supply tees should be approximately 3 ft. to prevent the turbulence of the water, created by the Flo Fitting, from affecting the flow of water to the Convector-radiators.

SUGGESTED DETAIL FOR A STOKER-FIRED INSTALLATION

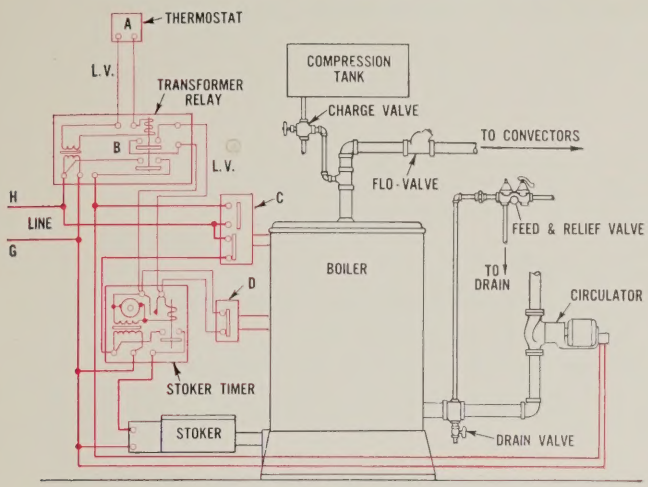


FIGURE 53

The low voltage thermostat "A" causes relay "B" to operate, closing two separate circuits—one to the stoker through its control and the other to the circulator. The combination high limit control "C" is so connected that should the boiler water overheat, the stoker will be shut down. This high limit control also serves to operate the circulator, should the "hold fire" control of the stoker cause it to overheat the boiler during the period that the room thermostat is not calling for heat. The low limit control "D" maintains a predetermined minimum boiler water temperature. The high limit control should be set for a temperature about 30° above the *design* temperature of the heating system. In the above details wiring and electrical equipment are in red.

SUGGESTED DETAIL FOR A HAND-FIRED INSTALLATION

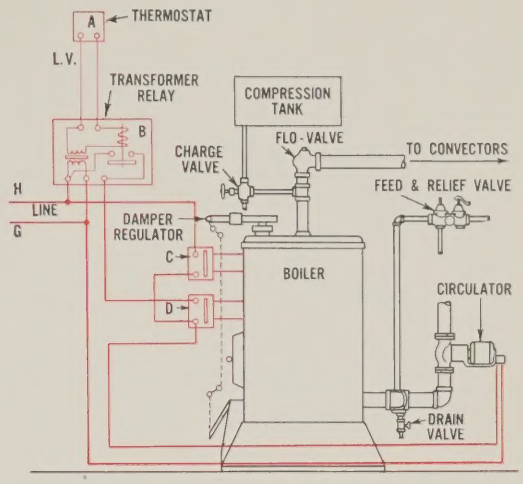


FIGURE 55

The low-voltage thermostat "A" controls the transformer relay "B" which operates the circulator. The low limit control "D", which is in series with the circulator, prevents operation of the circulator when the boiler water is cold. The high limit control "C" is connected to operate the circulator independently of the thermostat and relay, should the boiler water temperature rise above a predetermined limit. This high limit control should be set for a temperature of about 40° above the *design* temperature of the heating system. It is recommended that some form of damper regulator be provided which will control the fire in accordance with the boiler water temperature. This regulator should be set at about 10° above the system's *design* temperature.

SUGGESTED DETAIL AND WIRING DIAGRAM FOR OIL OR GAS-FIRED INSTALLATION WITH TWO ZONES

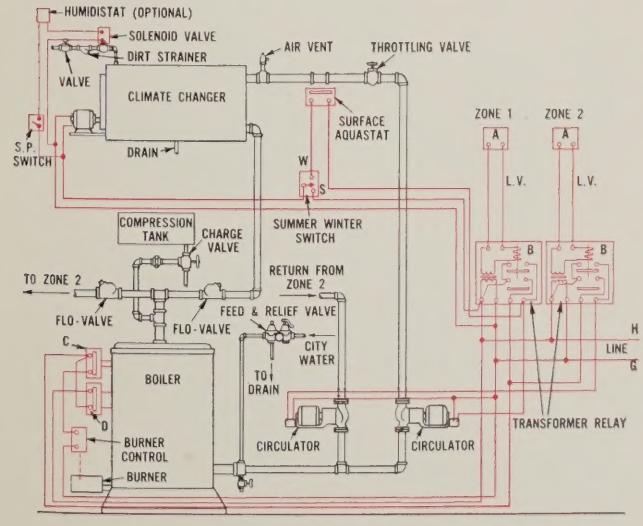


FIGURE 54

The Thermostat "A" in either of the two zones of this installation, will start the burner through the action of its transformer relay "B". Each thermostat, however, will operate only its own circulator. The high limit control "C" is so connected as to shut off the burner should the boiler water become overheated. This high limit control should be set about 30° above the *design* temperature of the heating system. The low limit control "D" serves to operate the burner independently of the thermostats and circulators, so as to maintain a minimum predetermined water temperature.

This diagram shows the piping connections and wiring diagram for a split system using one circulator for a Trane Climate Changer and the other circulator for the Trane Convector-radiators.

In this diagram, a humidistat and solenoid water valve are provided so that the proper relative humidity will be automatically maintained in the winter. A single pole switch is shown for breaking this circuit in the summer months.

A summer-winter switch is also provided so the Climate Changer can be used for air circulation in the summer, or, if equipped with cooling coils, for summer cooling as well. The surface aquastat in the winter serves to keep the Climate Changer fan from running until hot water has circulated through the heating coil.

SIZES OF RISERS AND BRANCHES WHERE ONE NO. 3 FLO FITTING HANDLES MORE THAN ONE CONVECTOR-RADIATOR

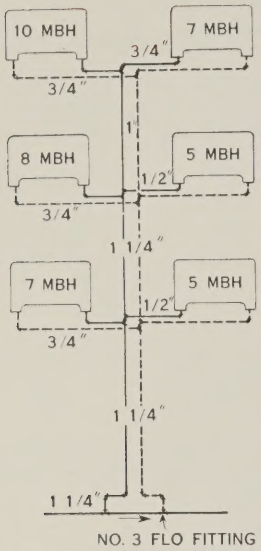


FIGURE 56

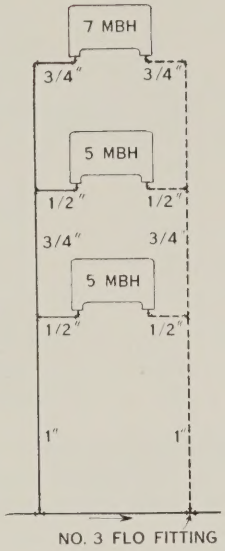


FIGURE 57

TABLE 13
MAXIMUM CARRYING CAPACITIES
OF IRON OR STEEL PIPE

½" PIPE SIZE	5.0 MBH
¾" PIPE SIZE	12.0 MBH
1" PIPE SIZE	18.0 MBH
1¼" PIPE SIZE	45.0 MBH

FIGURES 56 AND 57 SHOW TYPICAL PIPING CONNECTIONS FOR MULTIPLE CONVECTOR-RADIATOR ARRANGEMENTS AND ILLUSTRATE THE APPLICATION OF TABLE 13

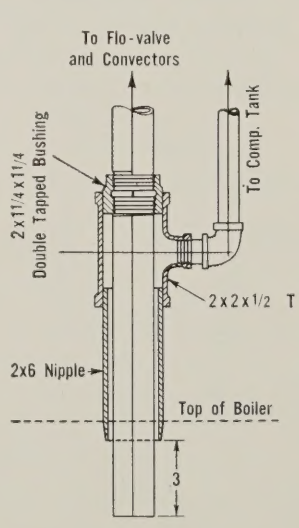
SUGGESTED BOILER CONNECTIONS FOR AIR ELIMINATION IN HOT WATER SYSTEMS

In a heating system air reaches the Convector from three sources — the small amount not displaced by water when the system is filled — the air present in the initial charge of water used to fill the system and the air which leaves the compression tank and works its way to the Convectors. Air from the first two sources can usually be quickly expelled because the amount is limited and it finds its way rapidly to the Convector and is vented.

The air in the compression tank is another problem however. Proper operation demands that a good charge of air be kept in the tank at all times. As air leaves the tank and accumulates in the Convector, it stops circulation in the Convector and must be vented. As this continues, the compression tank eventually runs out of air. The relief valve then spills water on firing cycles and the tank must be recharged with air. With a new charge of air the vicious cycle begins all over again.

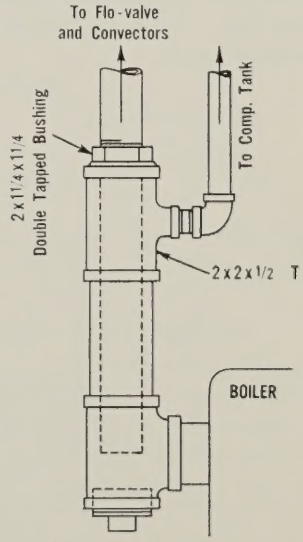
The boiler connection, shown in Figure 58, will virtually eliminate prolonged venting after a system has been installed and will also do away with the nuisance of a waterlogged compression tank. These results are accomplished by splitting the outlets to the main and to the compression tank. Air liberated within the boiler rises to the top and is discharged to the compression tank thru the space between the 2" and the 1¼" nipple. Air and water in the compression tank, returned to the boiler by expansion, are discharged into the very top of the boiler well above the entrance to the main, and as the air is liberated from this water it, too, rises to the tank. Figure 59 shows the same connection used on a side outlet boiler.

These connections are recommended on all Hot Water systems and may be accomplished with standard pipe fittings which the installing contractor can supply.



TOP OUTLET BOILER

FIGURE 58



SIDE OUTLET BOILER

FIGURE 59

ARCHITECTURAL SPECIFICATIONS

Circulator

Circulator shall be single suction, horizontal type, size ..... capable of delivering ..... gpm against a ..... foot head.

Motor shall be ..... horsepower, AC, 60 cycle single phase, oil lubricated, equipped with Thermal Over Load Protection. Motor shall be securely mounted in rubber end supports to eliminate vibration and noise.

Circulator body shall be of heavy, close-grained cast iron carefully machined to insure true performance. Flanged connections shall be used in connecting piping to Circulator. All moving Circulator parts shall be fully enclosed to protect impeller shaft and coupling connection. Impeller shall be of best grade stamped (cast for 2½" and 3" sizes) brass built for proper performance.

Seal between impeller shaft and bearing bracket shall be Teepelite carbon seal ring rotating against a ground and lapped cast iron surface. Flexible member of seal assembly shall be synthetic rubber. (Seal for 2½" and 3" sizes shall be Morganite seal ring rotating against highly machined and polished cast iron surface.)

Coupling shall be double engagement, non-metallic, flexible disc type, capable of handling both parallel and angular misalignment.

Flo Valve

Flo Valve should be of the Angle (Straightway) Type size ..... Flo Valve shall be tight sealing to prevent gravity circulation when Circulator is not operating. An adjustable lever shall be provided for locking Flo Valve open but Flo Valve must be designed so that it cannot be locked closed.

Flo Valve shall be of close-grained cast iron. Valve seat and valve gate shall be of machined bronze.

Flo Fittings

Furnish and install where shown on plans Flo Fittings of the sizes and types indicated. Flo Fittings shall be of the return fitting type and are to be of heavy close-grained cast ..... of the true Venturi type for maximum efficiency.

Automatic Feed and Relief Valve

An Automatic Feed and Relief Valve shall be used to maintain proper working pressures on the boiler. Valve shall be factory adjusted to 12-14 pounds final pressure. Monel screens shall be incorporated around valve seats in order to keep out dirt and insure proper seating of valve. Valve body to be of all bronze construction and seat on relief valve to be nickel plated. Valve shall include by-pass feature for quick filling system. Valve shall meet A.S.M.E. requirements for testing.

Relief Valve

A Relief Valve shall be used to insure the safe operation of the heating system. Valve shall be set to relieve pressures in excess of 28-30 pounds. Valve body and spring chambers shall be of bronze, diaphragms of phosphor-bronze and relief seat of bronze-nickel-chrome for long life. A try-lever shall be provided to permit occasional flushing and testing of the system.

Automatic Air Vent

An Automatic Air Vent shall be provided on all high points of mains to insure complete elimination of air. Body shall be of brass with Monel metal bearing and levers, copper float and Neoprene valve seat. Vent shall be satisfactory for pressures up to 80 pounds. Where Vent is installed over finished floors and ceilings, an emergency overflow connection to a drain shall be provided.

Charging Valve

A Compression Tank Charging Valve shall be provided at the Compression Tank to permit recharging the tank with air, without breaking piping connections. Valve body shall be of bronze, with Jenkins discs.

Compression Tank

Compression Tank size .... by .... shall be provided. Tank shall be of heavy gauge steel.

Convector-radiator

(Type A)

Convector-radiator elements shall be of a suitable type for use with any hot water heating system, and shall consist of round seamless copper tubes, non-ferrous fins, cast iron headers, steel side plates and tube supports of galvanized steel. Headers shall be provided with full size tappings, top and bottom at each end. Fins shall have carefully flanged collars which act as spacers in addition to providing permanent contact with the tubes. All tubes are to be mechanically expanded into fin collars. Tubes shall be expanded into headers and rolled with contact further strengthened by tapered brass bushings so inserted as to prevent tubes from loosening or pulling out by continued expansion.

Type A Convector-radiator cabinets (with dampers) shall be constructed with backs and end of enclosures of USS 20 gauge steel. Tops and fronts shall be of USS 18 gauge steel with all exposed corners rounded to a radius of ½". The fronts shall be secured in place by two quick opening fasteners near the top and two shoulder rivets near the bottom, and shall be removable by loosening the two quick opening fasteners. Grilles shall be of the free-flo or directional vane type stamped directly from the metal of the front panel. Inlet openings shall have edges formed back at the sides and top to eliminate exposed raw edges. Cabinet fronts shall be painted inside and outside with one coat of grey primer. Complete cabinets and Convector-radiator elements are to be manufactured by the same company.

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